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Pro-poor growth with limited intergenerational mobility: the case of overcrowding in Mexico *

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Abstract

Renewed interest in social mobility and inequality of opportunity in Mexico has motivated a vast data collection effort in the 21st century. Based mainly on analyses of income, wealth, education, occupation and labour market participation, the ensuing generation of studies portrays a consistent picture of a highly stratified society with significant intergenerational inertias at the tails of the distributions. But how about other valuable, yet unexplored, dimensions of wellbeing, e.g. dwelling conditions? Should we expect similar patterns of social reproduction? This paper studies intergenerational mobility in overcrowding, a dimension of wellbeing whose importance for Mexican policy-makers is exemplified by its inclusion in the country's multidimensional poverty index. Using a novel decomposition of absolute panel change into growth, structural mobility and exchange mobility components, we compute the change from parents to offspring in social welfare evaluation of overcrowding, intersecting age, gender and macro-regions; as well as age, gender and degree of urbanisation between generations. At all levels, we find that intergenerational average reductions in overcrowding in Mexico have also been pro-poor, although improvements in the mean amount to around 60% of total social welfare change. Meanwhile, the contribution of exchange mobility due to family re-rankings remains minimal, except among the youngest contemporary cohorts where it accounts for most of the inequality reduction component.

Keywords: Egalitarian growth, intergenerational mobility, overcrowding, Mexico.

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1. Introduction

Renewed interest in social mobility and inequality of opportunity in Mexico has motivated a vast data collection effort in the 21st century. Based mainly on analyses of income, assets, education, occupation and labour market participation, the ensuing generation of studies portrays a consistent picture of a highly stratified society with significant intergenerational inertias at the tails of the distributions (Serrano and Torche, 2010; Velez-Grajales et al., 2015). These results are also mediated by gender and regional gradients. For example, Velez- Grajales et al. (2013) find that women face higher probability of reproducing parental poverty and higher chances of downward social mobility when starting from privileged positions. Likewise, Delajara and Graña (2017) find that northerner adults enjoy better prospects of upward social mobility than their southern counterparts. But how about other valuable, yet unexplored, dimensions of wellbeing like dwelling conditions? Should we expect similar patterns of social reproduction?

This paper studies intergenerational mobility in overcrowding, one of several indicators used by Mexico's CONEVAL (2018) to operationalise the habitability dimension embedded in the UN's notion of adequate housing (UN-HABITAT, 2009). Moreover, overcrowding is one of the key ingredients in CONEVAL's multidimensional poverty index (with a deprivation line of 2.5 people per room including the kitchen). Likewise, the UN itself has used overcrowding as one of several sub-indicators to compute the proportion of urban population living in slums or informal settlements, both in the Millennium Development Goals and the Sustainable Development Goals. (Needless to say, it is just one aspect among several characterising the quality of dwelling conditions.) Using a novel decomposition of absolute panel welfare change (Seth and Yalonetzky, 2019) into components of growth, structural mobility (understood as change in inequality) and exchange mobility (due to dynastic re-rankings), we compute the change from parents to offspring in social welfare evaluation of overcrowding, intersecting age, gender and macro-region as well as age, gender and degree of urbanisation.

The first part of the assessment treats growth, inequality and relative mobility aspects in isolation: growth is measured with the average absolute change in overcrowding; change in inequality is measured with standard deviations (hence implementing the absolute approach to inequality measurement); and relative social mobility is computed with Spearman and Pearson correlation coefficients (the former being the slope from the popular rank-to-rank regression). Using the ESRU-EMOVI 2017 dataset collected by the CEEY centre specialising in the study of social mobility in Mexico, the analysis is performed throughout for age- cohorts of men and women (household heads and their spouses), both nationally and at the regional level. Then we also study the trends interacting cohorts and gender with degree of urbanisation, where the latter yields four groups of people: (1) urban-to-urban (lived in cities at age 14 and currently live in cities); (2) rural-to-rural (rural residence past and present); (3) rural-to-urban (lived in rural areas at age 14 and now live in cities); (4) urban-to-rural (lived in cities at age 14 and currently live in rural locations).

For most samples, we find that contemporary mean overcrowding remains stable across cohorts both at the national and regional levels as well as by degree of urbanisation, but with important regional differences (e.g. less than one person per room in the capital by contrast to between 1.5 and 2 people per room in the relatively poorer South). On the other hand, overcrowding when the adults were 14 years old has been steadily decreasing from older to younger cohorts across the board (with mean overcrowding levels of the oldest cohorts in several regions above the poverty line). Analogously, most regions and cohorts (as well as urbanisation groups) have experienced intergenerational reductions in absolute inequality. Finally, in several regions Spearman correlation values have increased with the youth of the cohort (albeit seldom monotonically).

While highly informative, this type of isolated assessment has its limitations. Social scientists have been interested in describing, and ethically judging, distributional change in wellbeing indicators across two (or more) periods for a long time now (e.g. discussion and references in Demuynck and Van de Gaer (2012), as well as in Jenkins and Van Kerm (2016); but also inter alia Cowell (1985), and cross-disciplinary work summarized in Handcock and Morris(1999). During the 21st Century this interest was further aroused by the development of concepts and statistical tools to measure notions of 'pro-poor' growth, which essentially emphasize wellbeing growth experiences accompanied by reductions in inequality and/or characterized by faster growth among the initially poorest (e.g. Ravallion and Chen (2003); Son (2004); Deutsch and Silber (2011); Ferreira (2012). Even recently, the UNDP adopted the Inequality-Adjusted Human Development Index (IADHI) (UNDP, 2018), which basically penalises attainments in each of its components for their degree of inequality (thus echoing Sen's welfare metric; Sen (1973). Faced with the alternative of tracking different distributional aspects of wellbeing in isolation (e.g. changes in mean attainment, distributional dispersion, etc.), ethical judgments of distributional change rely on social welfare functions and are interested in teasing out how different relevant aspects of distributional change (again, changes in the mean, dispersion, etc.) contribute to overall measures of change in social wellbeing.

Moreover, when tracking the same units across time we can decompose distributional change further into three components: average growth, structural mobility, and exchange mobility. The latter two concepts (structural and exchange mobility) come from an older sociology literature (e.g. Markandya, 1982). Nowadays, structural mobility is mainly understood as the component capturing distributional change due to anonymous changes in dispersion/inequality, whereas exchange mobility is deemed to encompass change due to non- anonymous re-rankings. These mobility concepts can be applied to either longitudinal data following the same agents of interest (e.g. people in intragenerational assessments) or retrospective data (e.g. families when studying intergenerational mobility). Several tools for this type of assessment exist in the literature (e.g. Van Kerm (2004), Demuynck and Van de Gaer (2012), Dhongde and Silber (2016), Jenkins and Van Kerm (2016) and references therein).

In the second part of the assessment, we use a measure of panel change in social welfare from overcrowding based on a class of generalised-Lorenz consistent indices (Palmisano and Van de Gaer, 2016; Bossert and Dutta, 2018; Seth and Yalonetzky, 2019) which are sensitive to average improvements (average reductions in overcrowding), inequality reduction, and re-rankings (exchange mobility). Hence, by combining the growth, structural mobility, and exchange mobility components, our measure of absolute panel change can tell us, for instance, not only whether overcrowding has decreased on average, but also whether that growth has been pro-poor, and if so, accompanied by relative social mobility or not; alongside a quantification of each components' contribution toward change in a measure of social welfare expressed in the same units as the wellbeing indicator. Additionally, unlike other proposals in the literature, the measures' decomposition into mobility components satisfies the three desirable properties (the "right" sensitivity to reductions in average overcrowding, reductions in absolute inequality and re-rankings) only with one particular decomposition procedure (thus without the need to average results across alternative decomposition choices).

Among several results, we find that (1) most of the welfare gains in overcrowding reduction in Mexico took place among the older cohorts, (2) the growth component predominates (around 60% for both men and women, nationally, across regions and degree of urbanisation), (3) overcrowding reduction is indeed pro-poor across the board; (3) the exchange-mobility component only contributes non-trivially among the younger cohorts; and (4) welfare gains in overcrowding reduction exhibit marginal decreasing returns with, for instance, relatively poor regions like the South experiencing the highest gains across all cohorts and relatively affluent regions like the capital city exhibiting the most moderate gains in the country.

The rest of the paper proceeds as follows. Section 2 provides the methodology, which summarises the key points of Seth and Yalonetzky (2019). Section 3 discusses the data. Section 4 and provides the first part of the analysis, i.e. the isolated assessment of growth, inequality and mobility. Section 5 provides the second part of the analysis, i.e. the assessment of absolute panel change in overcrowding from a social welfare perspective. Section 6 digs deeper into the drivers of the results by performing the analysis of sections 4 and 5 for the numerator and denominator of overcrowding separately, just at the national level. Finally, section 7 offers some concluding remarks.

2. Methodology

2.1. Notation and preliminaries

Consider n individuals. Let $x_1(i)$ be the value of wellbeing indicator (e.g. overcrowding) $x \in \mathbb{R}_+$ for individual i in period 1, from an n-dimensional vector $X_1 \in \mathbb{R}_+^n$, where $n \in \mathbb{N}/\{1\}$. Define the mean for period 1 as $\bar{x}_1 = \frac{1}{n}\sum_{i=1}^{n} x_1(i)$. Same definitions apply for period 2.

Individuals in both periods are ranked according to their income in period 1 such that $x_1(1) \leq x_1(2) \leq \cdots \leq x_1(n)$. (Hence $x_2(1) \leq x_2(2) \leq \cdots \leq x_2(n)$ would only hold in the absence of re-rankings in period 2).

We will also consider an alternative setting in which the distributions of each period are ranked in ascending order independently. Hence we will have X_1 as before, but now accompanied by a vector for period 2: $Y_2 = \{y_2(1), y_2(2), \ldots, y_2(n)\}$ such that: $y_2(1) \leq y_2(2) \leq \ldots \leq y_2(n)$ and $Y_2 = X_2$ only in the absence of re-rankings between periods 1 and 2. Otherwise $Y_2 = X_2 P$ where P is a $n \times n$ permutation matrix. Hence x_2 is the common mean to both distributions X_2 and Y_2.

Finally, we can also consider the vector $Y_1 = \{y_1(1), y_1(2), \ldots, y_1(n)\}$ which provides the incomes of period 1 but ranked according to the values in period 2. Hence $Y_1 = X_1$ only in the absence of re-rankings between the periods. Otherwise $Y_1 = X_1 P$ where P is a $n \times n$ permutation matrix. And, of course, X_1 and Y_1 have the same mean $\bar{x}_1$. The example in Table 1 clarifies the relationship between the four distributions: X_1, Y_1, X_2, Y_2:

Table 1: Hypothetical distributions in two periods

i	X_1	Y_1	X_2	Y_2
1	67	120	130	70
2	88	100	115	80
3	100	67	70	115
4	120	88	80	130

Finally, we define the following differences (and their respective vectors): $\Delta x(i) \equiv x_2(i) - x_1(i) \in \Delta X$; $\Delta y2x1(i) \equiv y_2(i) - x_1(i) \in \Delta Y2X1$; $\Delta y2x2(i) \equiv y_2(i) - x_2(i) \in \Delta Y2X2$; $\Delta y1x1(i) \equiv y_1(i) - x_1(i) \in \Delta Y1X1$; and $\Delta \bar{x} \equiv \overline{x_2} - \overline{x_1}$.

2.2. A class of measures of panel deprivation change

Seth and Yalonetzky (2019) adapted the measures of pro-poor panel change proposed by Palmisano and Van de Gaer (2016) in order track changes in social evaluations of deprivation. Since an increase in overcrowding is associated with a decrease in wellbeing, we will focus the presentation on the measures of destitution in equation 1:

$$A(\Delta X, \delta) = \sum_{i=1}^{n} \beta(i; \delta, n) \Delta x(i), \quad \delta > 1 \quad (1)$$

where: $\beta(i; \delta, n) \equiv \frac{i^\delta - (i-1)^\delta}{n^\delta}$. As shown in Seth and Yalonetzky (2019), $A(\Delta X, \delta)$, as a measure of change in social evaluations of destitution, satisfies the following three key properties:

Axiom 2.1 *Monotonicity (M): if $x_2(i) < x_1(i)$ for at least one i and $x_2(j) = x_1(j)\ \forall j \neq i$, then $A(\Delta X, \delta) < 0$.*

Monotonicity means that if, ceteris paribus, X_2 is obtained from X_1 by reducing at least one person's (or family's) deprivation level (e.g. overcrowding), then the social destitution measure, A, should decrease signalling a welfare improvement.

Axiom 2.2 *Inequality (I): if $x_1(i) < x_2(i) \leq x_2(j) < x_1(j)$ for at least one pair i, j and $x_2(k) = x_1(k)\ \forall k \neq \{i, j\}$, then $A(\Delta X, \delta) < 0$.*

The Inequality property means that if X_2 is obtained from X_1 through a sequence of rank-preserving progressive transfers from the better-off to the worse-off, then the social destitution measure should also decrease signalling a welfare improvement. Effectively, this property places a social evaluation penalty on an uneven distribution of overcrowding. This property also ensures that the social evaluation measure will decrease further if the same absolute improvement in overcrowding is experienced by a family which was initially more deprived in that dimension.

Axiom 2.3 *Rerankings (R): if* $(x_2(i) - x_2(j))(x_1(i) - x_1(j)) < 0$ *for at least one pair* $i, \boldsymbol{j}$ *and* $x_2(k) = x_1(k)\, \forall k \neq \{i, \boldsymbol{j}\}$, *then* $A(\Delta X, \delta) < 0$.

Re-rankings means that the social destitution measure decreases if pairs of people (or families) switch ranks between periods. So, even if X_2 is obtained from X_1 just by permutating values (without any changes in them) then $A(\Delta X, \delta) < 0$. In other words, it is a favourable assessment of exchange mobility. While this assessment may be ethically controversial, favourable sensitivity to exchange mobility is a logical consequence of privileging the progress of those initially most destitute.

In the following subsection we explain how a subclass of A can be decomposed into growth and inequality components. Then we show how the inequality component, in turn, can be decomposed into structural and exchange mobility components.

2.2.1. Decomposition of A into growth and inequality components

Following Palmisano and Van de Gaer (2016), Seth and Yalonetzky (2019) show that A can be decomposed into a growth and inequality component:

$$A(\Delta X, \delta) = \underbrace{I(\Delta X, \delta)}_{\{inequality\ component\}} + \underbrace{\Delta \bar{x}}_{\{growth\ component\}} \quad (2)$$

where:

$$I(\Delta X, \delta) = \sum_{i=1}^{n} \beta(i; \delta, n)[\Delta x(i) - \Delta \bar{x}] \quad (3)$$

I is the element of the measure of change in social destitution rewarding pro-poor improvements, here understood as larger $\Delta x(i)$ for those starting with high values of the destitution indicator in period 1, i.e. x_1. Clearly, if $\Delta x(i) = \Delta \bar{x}, i = 1, 2, \ldots, n$ then $I(\Delta X, \delta) = 0$ and $A(\Delta X, \delta) = \Delta \bar{x}$. Otherwise, $I(\Delta X, \delta) < 0$, signalling pro-poor destitution alleviation, if, in general, $\Delta x(i) - \Delta x$ is more negative among those with higher x_1 (and hence higher $\beta(i; \delta, n)$).

2.2.2. Decomposition of the inequality component into structural and exchange mobility elements

Traditionally, the mobility elements in most decompositions are isolated using counterfactual distributions, either Y_1 or Y_2. The exchange-mobility component is related to either the change between X_1 and Y_1, or X_2 and Y_2 (i.e. pure re-rankings) whereas the structural mobility component relates to either the change between Y_1 and X_2 (if the exchange component is based on the change between X_1 and Y_1) or the change between Y_2 and X_2 (if the exchange component is based on the change between X_1 and Y_1. But Seth and Yalonetzky (2019) show that in the case of decomposing the total inequality component I, only the decomposition using Y_2 as counterfactual distribution yields components satisfying the three key aforementioned axioms (including, chiefly, satisfaction of the inequality axiom by the structural mobility component). Therefore:

$$I(\Delta X, \delta) = \underbrace{I(\Delta Y_2 X_1, \delta)}_{\{structural\ mobility\}} + \underbrace{I(\Delta X_2 Y_2, \delta)}_{\{exchange\ mobility\}} \quad (4)$$

$I(\Delta Y_2 X_1, \delta)$ measures change in absolute inequality in the absence of re-rankings, i.e. the structural mobility component. It is the difference between indices from a class of absolute-Lorenz-consistent inequality indices $I(\Delta Y_2 X_1, \delta) = \sum_{i=1}^{n} \beta(i; \delta, n)[y_2(i) - \overline{x_2}] - \sum_{i=1}^{n} \beta(i; \delta, n)[x_1(i) - \overline{x_1}]$). This class of rank-dependent inequality indices includes the absolute Gini, among others.

Meanwhile, $I(\Delta X_2 Y_2, \delta)$ measures reductions in inequality due to re-rankings, i.e. the exchange mobility component. Seth and Yalonetzky (2019) show that, unlike the structural component, the exchange mobility component is either negative or null (in the absence of re-rankings), whenever $A(\Delta X, \delta)$ is a measure of change in social destitution (as in the case of overcrowding). In other words, re-rankings, i.e. exchange mobility, are always deemed welfare-enhancing with these measures of absolute distributional change. By contrast, structural mobility is only welfare-enhancing if it reflects inequality reduction.

2.2.3. Percentage representation of the decomposition

Seth and Yalonetzky (2019) show how to write the full decomposition in terms of percentage contributions. Let $g = \frac{\Delta \bar{x}}{A(\Delta X, \delta)}$ be the growth component, $s = \frac{I(\Delta Y_2 X_1, \delta)}{A(\Delta X, \delta)}$, and $e = \frac{I(\Delta X_2 Y_2, \delta)}{A(\Delta X, \delta)}$ be the exchange mobility component. Then:

$$g + s + e = 1. \quad (5)$$

The percentage decomposition in equation 5 conveniently satisfies a property of scale invariance. That is, let $Z_1 = \lambda X_1$ and $Z_2 = \lambda X_2$ for $\lambda \in \mathbb{R}_{++}$. Then for all $\delta > 1$: $g(\Delta X, \delta) = g(\Delta Z, \delta)$, $s(\Delta X, \delta) = s(\Delta Z, \delta)$ and $e(\Delta X, \delta) = e(\Delta Z, \delta)$. Moreover, $A(\Delta X, \delta)$ and all its components, together with the percentage decomposition, satisfy translation invariance, whereby if $Z_1 = X_1 + \gamma$ and $Z_2 = X_2 + \gamma$ for $\gamma \in \mathbb{R}$, then

$A(\Delta X, \delta) = A(\Delta Z, \delta)$ for all $\delta > 1$, and the same goes for all the other components (including those of the percentage decomposition). The percentage decomposition will be used to present the decomposition results in the second part of the analysis.

3. Data and related methodological choices

We use the ESRU-EMOVI 2017 dataset collected by the Centro de Estudios Espinosa Yglesias (CEEY). We measure overcrowding dividing the number of people in the household by the number of rooms including the kitchen; i.e. the same indicator used by CONEVAL in the construction of Mexico's multidimensional poverty index. Of course, overcrowding is only a partial indicator of dwelling conditions. It only captures the quantity of available rooms per family member, without accounting for those rooms' quality or any other relevant dwelling conditions (e.g. floor, walls, and ceiling material; heating; electricity; indoor plumbing; location in disaster-prone areas, etc.).[1]

We focus on households that share food and are headed by adults aged 25-64. The analysis is performed separately for male and female adults who are either heads of household or spouses. We cover both the national level and the six macro regions of Mexico separately: North (comprising the states of Baja California Norte, Sonora, Coahuila, Chihuahua, Nuevo Leon, Tamaulipas), North-west (Baja California Sur, Zacatecas, Sinaloa, Nayarit, Durango), Center-north (Jalisco, San Luis Potosi, Colima, Michoacan, Aguascalientes), Center (Mexico City, Guanajuato, Queretaro, Morelos, Hidalgo, Puebla, Mexico, Tlaxcala) and South (Guerrero, Chiapas, Oaxaca, Quintana Roo, Tabasco, Campeche, Yucatan, Veracruz). We also provide results specifically for Mexico City. We construct the following eight birth co- horts (with ages in 2017 in parenthesis): 1988-1992 (25-29), 1983-1987 (30-34), 1978-1982 (35-39), 1973-1977 (40-44), 1968-1972 (45-49), 1963-1967 (50-54), 1958-1962 (55-59), 1953-1957 (60-64) (smallest regional sample size 62 for men and 110 for women, largest regional sample size 323 for men and 443 for women, see Tables 2 and 3).

By way of delving deeper into the drivers of the observed distributional change we also explore the interaction between cohort-gender (of heads and spouses) and degree of urbanisation. Bearing in mind that the ESRU-EMOVI 2017 deems rural any location with fewer than 2,500 inhabitants, the degree of urbanisation is operationalised by dividing the sample into four groups: (1) urban-to-urban, comprising people who lived in urban areas (cities for short) when they were 14 years old and currently live in cities; (2) rural-to-rural, made of people who lived in rural areas when they were 14 years old and now also live in rural areas; (3) rural-to-urban, comprising people who grew up in rural areas when they were 14 years old and currently live in cities; and (4) urban-to-rural, made of people who grew up in cities when they were 14 years old and now live in rural areas.

[1] CONEVAL (2018) provides a detailed discussion of the plethora of indicators used to diagnose the fulfilment of the right to a dignified and decorous dwelling, ranging from access to housing subsidies to perceptions of insecurity in the neighbourhood and so forth.

The respective sizes for the urbanisation-cohort-gender subsamples are in Table 4. Clearly, the sizes for the urban-to- rural samples are too small, reflecting the relative infrequency of de-urbanisation in countries like Mexico. Hence the estimates for this population group are bound to be highly imprecise and less reliable vis-a-vis the other urbanisation groups'. We still present them for the sake of completeness.

Finally, we construct the social welfare functions using $\beta(i;\ 2,n)$ in order to compute decomposable measures of absolute distributional change for indicators of destitution.

Table 2: National and regional sample sizes

	National		North		North-west		Center-north	
Cohort	Male	Female	Male	Female	Male	Female	Male	Female
1988 - 1992	600	1,072	107	194	83	133	84	177
1983 - 1987	576	920	112	168	62	111	101	167
1978 - 1982	648	1,426	141	301	80	159	91	224
1973 - 1977	720	1,384	125	255	91	158	107	250
1968 - 1972	664	1,183	125	210	94	144	109	220
1963 - 1967	702	909	147	156	79	117	107	183
1958 - 1962	547	749	92	141	68	91	111	127
1953 - 1957	1,100	1,221	184	216	152	189	193	232

Table 3: Regional sample sizes

	Center		Mexico City		South	
Cohort	Male	Female	Male	Female	Male	Female
1988 - 1992	222	336	149	202	104	232
1983 - 1987	187	267	124	157	114	207
1978 - 1982	200	443	116	280	136	299
1973 - 1977	235	384	130	195	162	337
1968 - 1972	173	334	92	195	163	275
1963 - 1967	216	249	124	133	153	204
1958 - 1962	162	220	98	120	114	170
1953 - 1957	323	356	149	191	248	228

4. Growth, inequality and exchange mobility in overcrowding in Mexico: a preliminary assessment of dimensions of wellbeing in isolation

4.1. National level

Figure 1 shows the national series of mean overcrowding for the eight cohorts of male and female adults. The "menmean" line refers to current average overcrowding of male adults' dwellings, whereas "men14mean" refers to the average overcrowding condition at the male

Table 4: Sample sizes by degree of urbanisation

Cohort	Urban-to-urban		Rural-to-rural		Rural-to-urban		Urban-to-rural	
	Male	Female	Male	Female	Male	Female	Male	Female
1988 - 1992	451	704	37	107	99	235	13	26
1983 - 1987	395	597	45	89	124	215	12	19
1978 - 1982	460	947	50	128	123	309	15	42
1973 - 1977	463	812	59	156	179	368	19	48
1968 - 1972	413	695	75	126	168	330	8	32
1963 - 1967	456	552	67	88	163	249	16	20
1958 - 1962	323	418	56	72	156	234	12	25
1953 - 1957	646	679	111	107	323	407	20	28

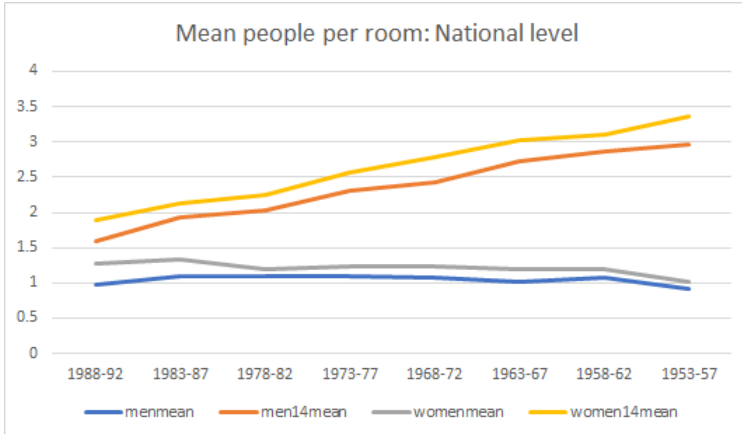
adult respondents' dwellings when they were 14 years old. Similar definitions apply to "womenmean" and" women14mean" involving the sample of female adults.

Several features are worth highlighting. Firstly, mean overcrowding at 14 has been steadily declining from the oldest cohort to the youngest. Younger adults spent their adolescence in less crowded dwellings. Secondly, mean overcrowding at age 14 was higher than CONEVAL's deprivation line of 2.5 people per room (including kitchen) among the five older cohorts of women (by contrast to only the oldest cohort for men). Meanwhile, current mean overcrowding remains surprisingly similar across cohorts, at about one person per room, albeit with a slight increase among female younger cohorts. Hence, we can already notice that greater absolute gains in mean overcrowding reduction accrued to the older cohorts. In fact, while the oldest cohort of men saw a relief of 2 people per room, the youngest has only experienced about a 0.5 people-per-room reduction. For women, the oldest cohort saw an improvement of 2.5 people per room, while the youngest only improved by slightly more than 0.5 (partly because younger women came from less overcrowded houses on average, but also because their current overcrowding conditions are worse than those of women from older cohorts). Finally, for both current and past overcrowding conditions, women on average live in worse-off dwellings vis-a-vis men.

Table 5 in the appendix, shows the p-values for two-tailed t-tests of genders differences in current and past (at age 14) mean overcrowding. At the national level the aforementioned gender differences are all statistically significant at 10% level of significance.

Figure 2 shows the national series for the standard deviation of overcrowding for the eight cohorts of both genders. The "mensd" line refers to current dispersion in men's overcrowding (as measured by the standard deviation), whereas "men14sd" refers to the dispersion in overcrowding when male adult respondents' were 14 years old. Similar definitions apply to "womensd" and "women14sd" involving the sample of female adults. We note that the current standard deviation is relatively stable across cohorts, varying between 0.6 and 1, and always higher among women. Meanwhile, the standard deviation of overcrowding at 14 has been declining from older to younger cohorts, albeit not always monotonically. It is also higher among women. Hence, we can ascertain, again, that the largest gains in social welfare due to inequality reduction in overcrowding have been accrued by the older cohorts.

Figure 1: Mean overcrowding: national level



In fact, the gap between the current and 14-year-old standard deviations is quite narrow among the youngest cohort, especially women's. In part, this result reflects consistently the trends in the mean: as mean levels of overcrowding move away from high values and get closer to 0 (the lowest possible value), the scope for dispersion in the indicator decreases accordingly. Hence the mean and dispersion reduction come together, partly due to an artefact of the variable, partly to genuine anonymous pro-poor growth (the poorest percentiles experiencing larger reductions in overcrowding).

Figure 2: Standard deviations: national level

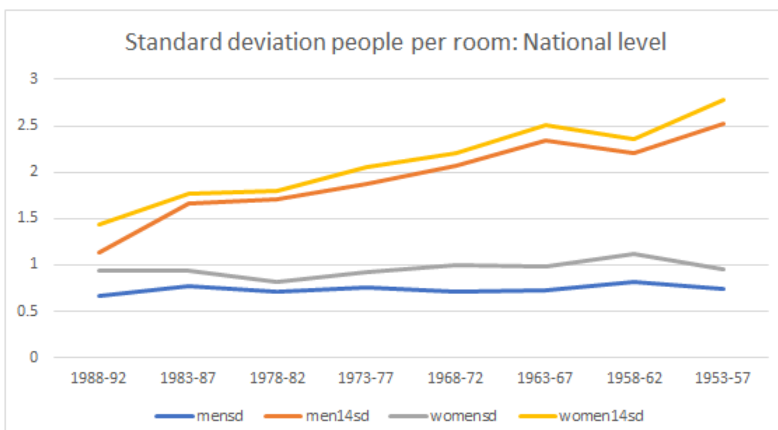
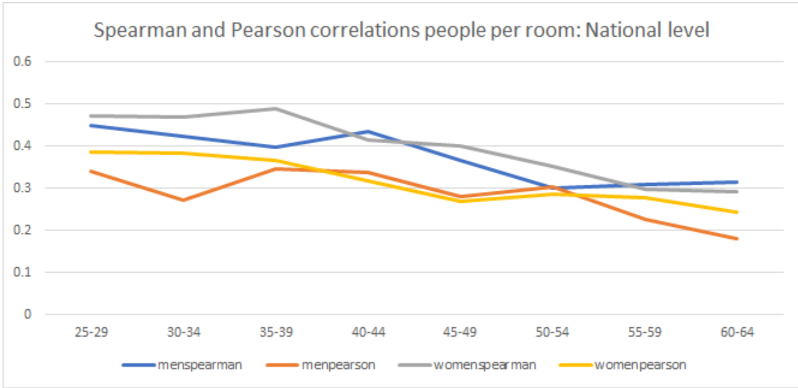


Figure 3 shows the national series for the Spearman rank-correlation coefficient and Pearson product-moment correlation coefficient, both linking current overcrowding with the levels at 14, computed for each male and female cohort. The reader is reminded that, in the absence of ties, the Spearman rank-correlation coefficient is identical to the slope coefficient of a rank-to-rank regression with constant term. Meanwhile, the properties of the Pearson correlation coefficient as a mobility index have been studied by Shorrocks (1993).[2]

[2] The Pearson correlation coefficient is invariant to data translations or ratio-scaling and responds positively to rearrangements that render the rankings associated with the two variables more similar. However, it is sensitive to outliers.

The Spearman series show increasing trends for both genders, from about 0.3 for their respective oldest cohorts until about 0.46 for their youngest cohorts, thereby signalling a reduction in rank mobility. The Pearson series concur with similar trends, though the increases are not monotonic for all four series.

Figure 3: Spearman and Pearson correlations: national level



4.2.Regional level

As expected, there will be both inter-regional similarities and differences as well as vis-a-vis the national average. Figures 4 to 9 show the means and standard deviations for people per room in each of the six regions. The trends are similar to those observed at the national level, but each region has its own distinctive features. For example, take the South and Mexico City. As perhaps expected, people in the South come, on average, from more overcrowded houses (when they were 14) than in Mexico City, for each cohort, even the youngest cohorts where the gap in childhood overcrowding is narrower. Meanwhile, current overcrowding is similar across cohorts within each region, with mild increases in overcrowding among the younger cohorts in most cases. But cross-regional differences persist in current measures of overcrowding. For example, on average, all cohorts in the South live in more crowded houses than their respective counterparts in Mexico City (less than one person per room for both genders throughout). In terms of averages, we also note that the oldest cohorts lived in households with overcrowding above CONEVAL's poverty across all regions, with the exception of Mexico City (barely better than the poverty line in the case of women).

Also mimicking the national results, the largest gains in overcrowding reduction tend to occur among the older cohorts in most regions-gender combinations. Likewise, the largest gains in inequality reduction (as measured by the standard deviation) have been accrued by the oldest cohorts. As mentioned before, inequality reduction might partly be an artefact of the decrease of mean overcrowding toward its lower bound.

Tables 7, 9, 11, 13, 15 and 17 in the appendix show the p-values for two-tailed t-tests of gender differences in current and past mean overcrowding for the six regions. Unlike the national level, most cohort-region differences are not statistically significant at 10%, which is not surprising given the smaller sample sizes. Still several cohort-region differences do emerge significant, even at 1%. In particular, the gender differences in current overcrowding among the two youngest cohorts are significant at 1% *across all regions*, a remarkable result.

Figure 4: Mean and standard deviation: Northern region

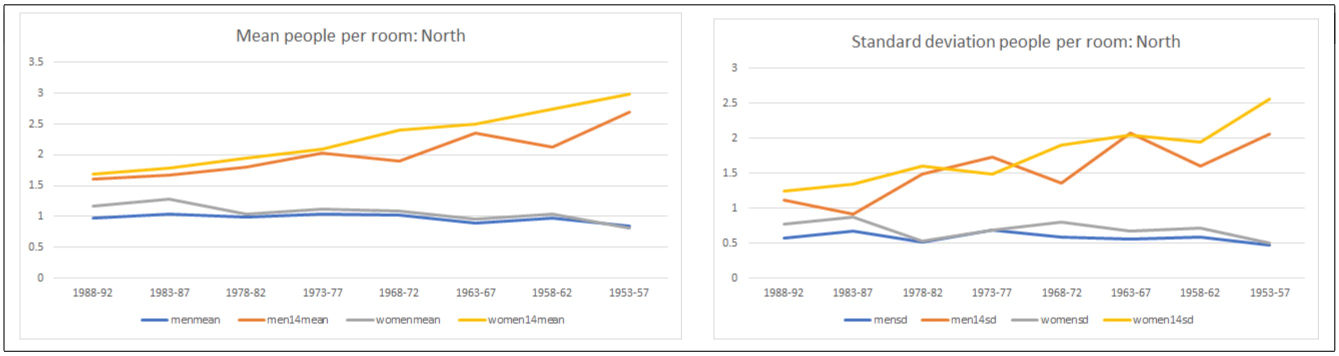


Figure 5: Mean and standard deviation: North-western region

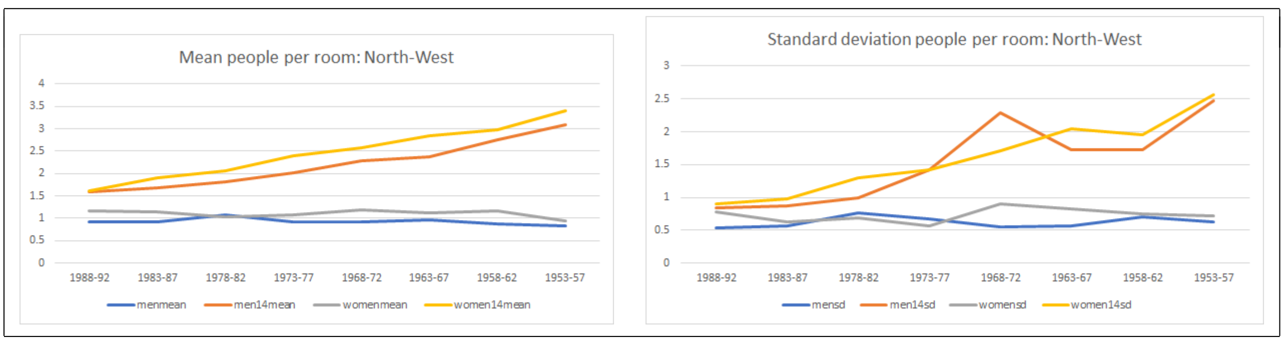


Figure 6: Mean and standard deviation: Centre-north region

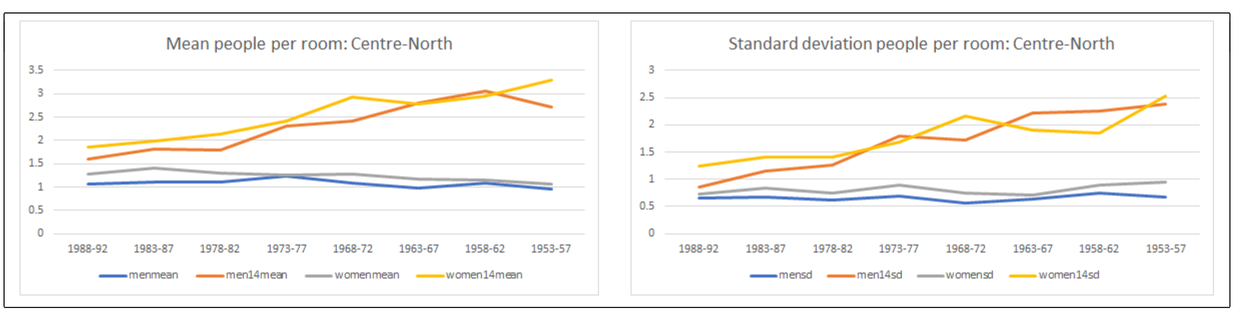


Figure 10 shows the Spearman correlation coefficients for region-gender combinations. In the case of men, regional differences in trends are noteworthy. Also, few trends are discernible. For example, the series for Mexico City are all over the place, with a peak of nearly 0.6 for the 40-44 cohort immediately followed by a trough of near 0.2 in the subsequent cohort (35- 39). Interestingly, diversity in Spearman values across regions is lower among the younger

Figure 7: Mean and standard deviation: Central region

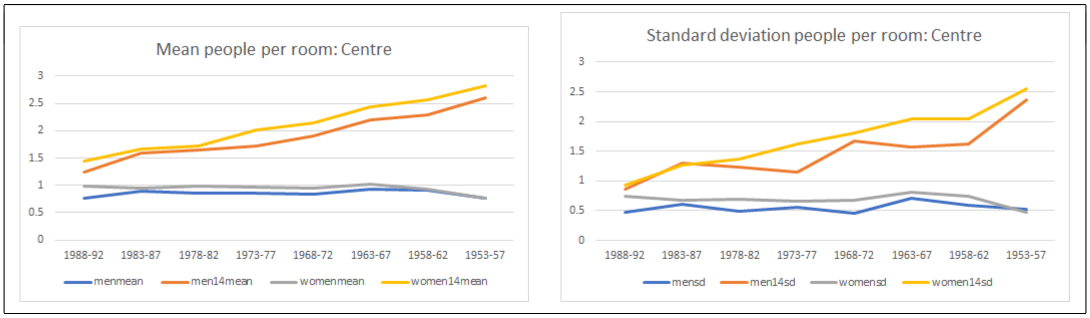


Figure 8: Mean and standard deviation: Mexico City

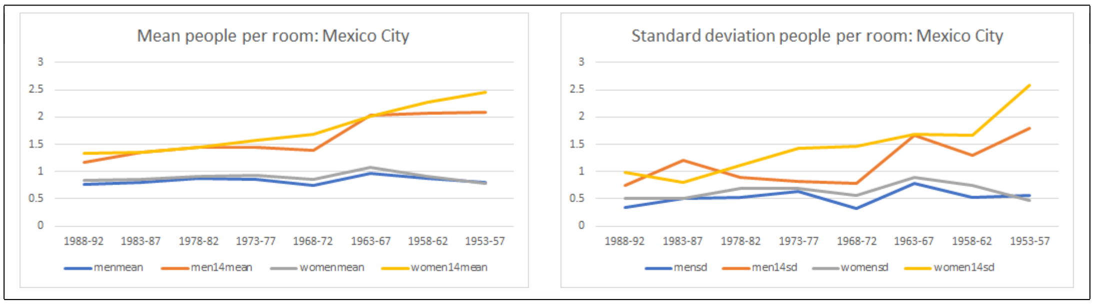
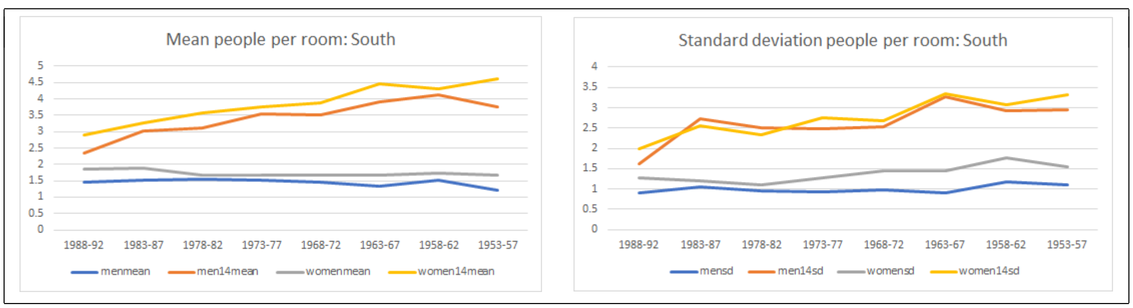


Figure 9: Mean and standard deviation: Southern region



cohorts. This would signal more similar patterns of regional relative mobility among those younger. Meanwhile the female series do show (mostly non-monotonic) increases in the Spearman values across regions from older to younger cohorts, hinting at a reduction in relative mobility for women throughout regions.

Figure 11 shows the Pearson correlation coefficients for region-gender combinations. It is hard to spot any clear cohort-related patterns for both men and women, except for fluctuations (more pronounced in Mexico City). Cases vary significantly. For example, the Pearson coefficient for women in the South has remained relatively stable. Interestingly, for most of the cohort-gender combinations, Mexico City exhibits the largest (or second-largest) Pearson correlation coefficient. This is consistent with the results for the Spearman coeffitient, hinting at lower relative mobility among people currently living in the capital vis-a-vis other regions.

Figure 10: Spearman correlation coefficients

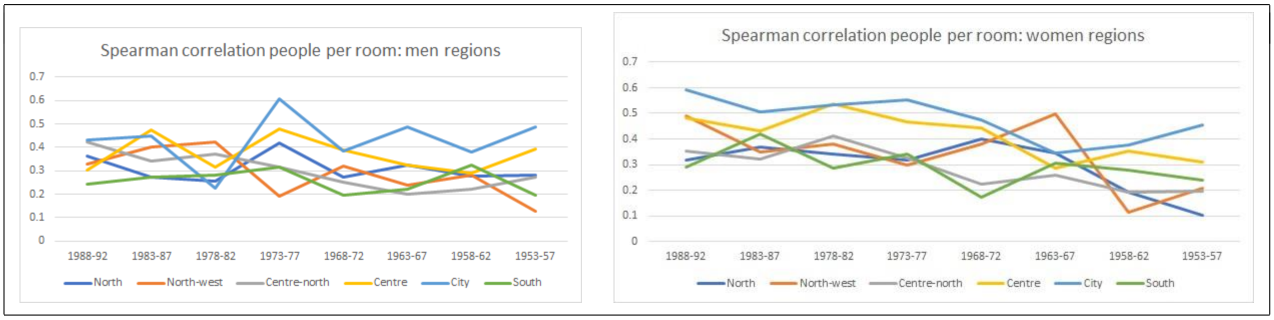
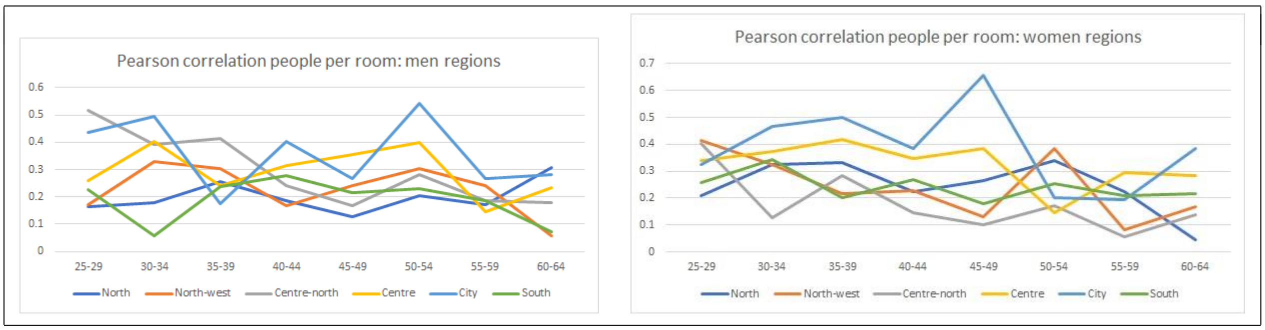


Figure 11: Pearson correlation coefficients



5. Growth, inequality and exchange mobility in overcrowding in Mexico: a joint assessment of absolute panel change

The previous assessment looked at changes in average overcrowding, inequality (from an absolute perspective), and relative social mobility; all in isolation. Now we combine these aspects into a joint ethical assessment of absolute distributional change where mean overcrowding reduction is valued alongside inequality reduction and relative social mobility in the form of intergenerational re-rankings.

5.1. National level

Figure 12 shows the national series for the measure of social destitution, $A$with $\beta(i;\ 2, n)$, for male and female adults. Since these measures are differences of weighted averages, their units are also people per room. Several features are noteworthy. Firstly, all cohorts, male and female, experienced improvement in overcrowding. Secondly, older cohorts experienced the largest gains in overcrowding reduction. In fact, weighted overcrowding decreased more than three persons per room for the oldest cohort, whereas it went down by one person per room for the youngest cohort. Note that these improvement values are greater than those that could be deduced from figure1(looking at mean reductions); hence suggesting pro-poor growth. For the older cohorts, the gains in overcrowding reduction are larger for women vis-a-vis men, whereas they nearly overlap among the two youngest cohorts (with slightly larger gains for men vis-a-vis- women in the youngest cohort).

Figure 12: Absolute panel change: national level

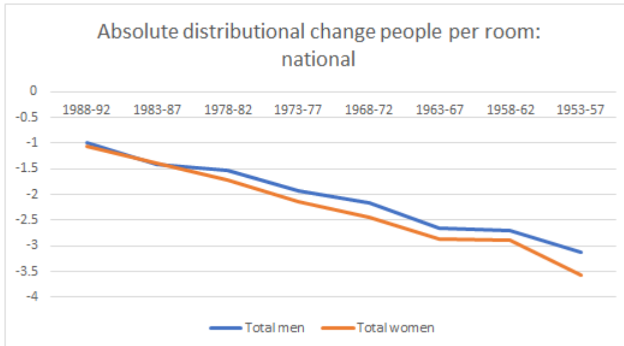


Figure 13 shows the decomposition of A with $\beta(i;\ 2, n)$, for the national sample of male and female adults. Firstly, we note that across cohorts the main driver of social welfare improvement is the mean decrease in overcrowding, explaining at least 60% of the decrease in the social destitution measure (except for the two youngest cohorts of women, where it stands at slightly less than 60%). Secondly, the remainder 40-odd % in welfare gain is provided by inequality reduction. Hence, we can conclude that overcrowding reduction among both male and female adults was pro-poor at the national level. Thirdly, the bulk of the inequality reduction is explained by structural mobility. Only among the younger cohorts we notice the predominance of exchange mobility, i.e. re-rankings, in the inequality component.

Figure 13: Growth, structural and exchange mobility components: national level

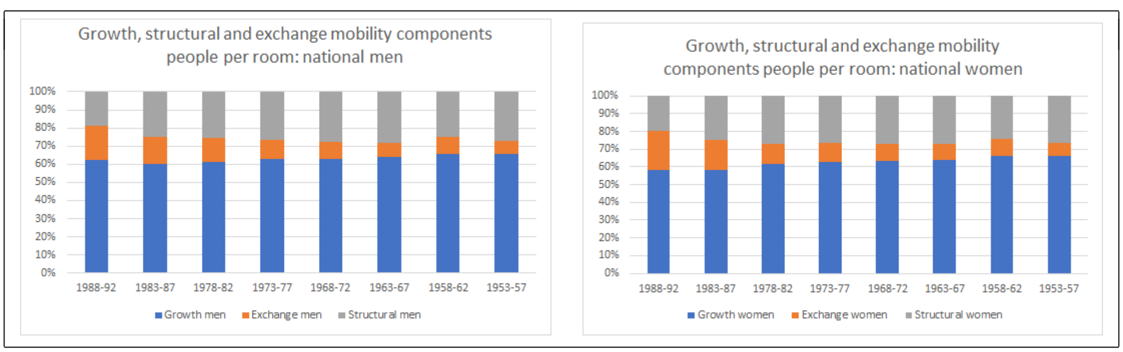


Table 6 in the appendix, shows the p-values for two-tailed t-tests of gender differences in absolute panel change A as well as its three components (growth, structural mobility, exchange mobility). Only the differences in A and $\Delta\bar{x}$ for the oldest cohort is significant at 10%. This means that, while several gender difference in *mean levels* of overcrowding appear significant, most (weighted and unweighted) *changes* are not.

5.2. Regional level

Figure 14 shows the regional series for the measure of social destitution, A with $\beta(i;\ 2, n)$ for male and female adults, on the left and right panels respectively. All cohorts in all regions experience welfare improvements, but with significant heterogeneity. For instance, in the case of male adults, the South features the largest gains among all regions for each cohort, ranging from about four persons per room in the oldest cohort to 1.5 in the youngest. On the other extreme, Mexico City shows the lowest gains for each cohort (except for the second oldest, where the North shows slightly lower gains). These results are consistent with higher initial levels of overcrowding in the South and lower initial levels in Mexico City. In other words, improvements in overcrowding seem to follow diminishing marginal returns. Trends look very similar for women, with the South again accruing the largest gains and Mexico City exhibiting the lowest gains (except for the youngest cohorts, where the gains in the Center and North-west are slightly smaller).

Figure 14: Absolute panel change: regional level

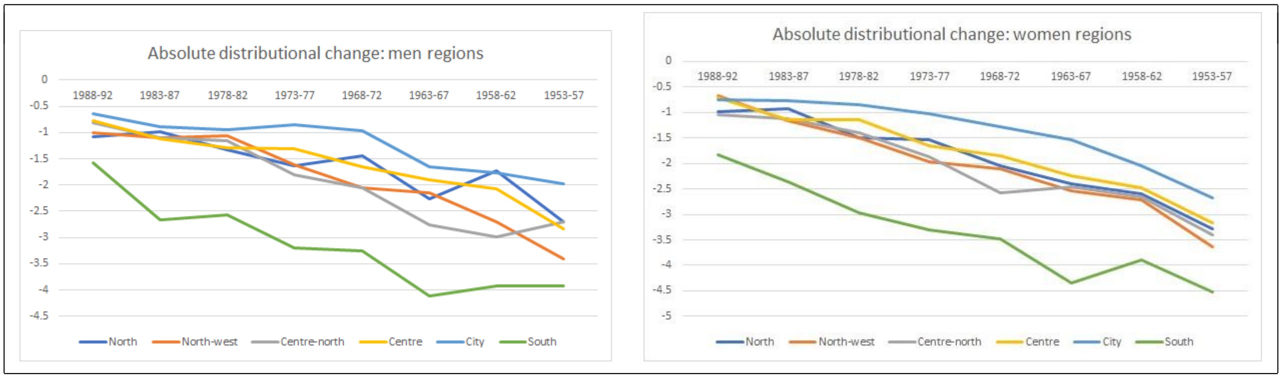


Figure 15 shows the regional series of the growth component for male and female adults, on the left and right panels respectively. Most growth contributions explain 60% to 70% of absolute distributional change. In most regions the growth component has slightly decreased from older to younger male cohorts. The clearest such case is the South's where the growth component declined from nearly 65 % to roughly 57%. Meanwhile, among women, the growth component explains between 50% and 70% of absolute distributional change. Most regions show declines in the growth component from older to younger female cohorts as well, in particular the North, Centre-North, and South. Remarkably, the regional growth contributions appear concentrated among the older cohorts and then diverge among the younger cohorts, for both genders. In a nutshell, the largest contributor to welfare improvement is the growth component in all region-cohort-gender combinations. Meanwhile, the overall inequality contribution (structural plus exchange mobility) remains significant, never lower than 29%.

Figure 16 shows the regional series of the structural-mobility component for male and female adults, on the left and right panels respectively. The structural component is almost never higher than 30% of absolute distributional change (the exception being Mexico City's oldest cohort at 32.5%). Moreover, for most regions this component has declined with the youth of the cohort (albeit seldom monotonically).

Figure 15: Share of growth component: regional level

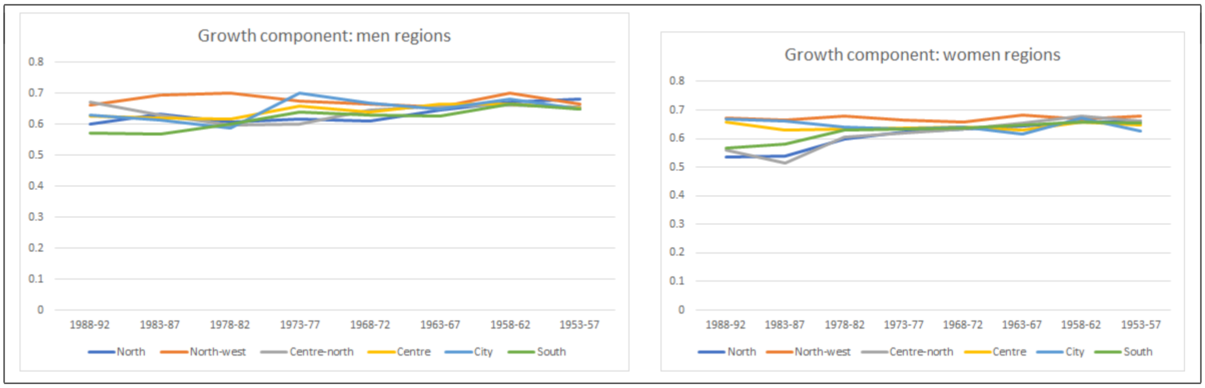
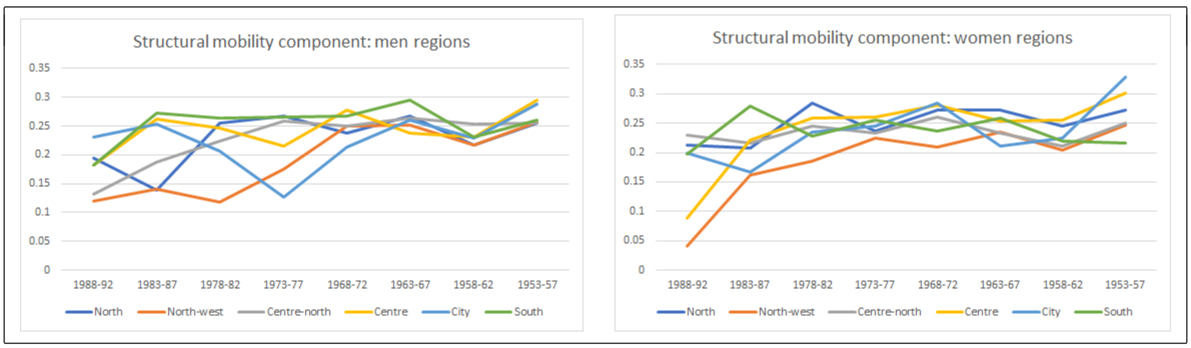
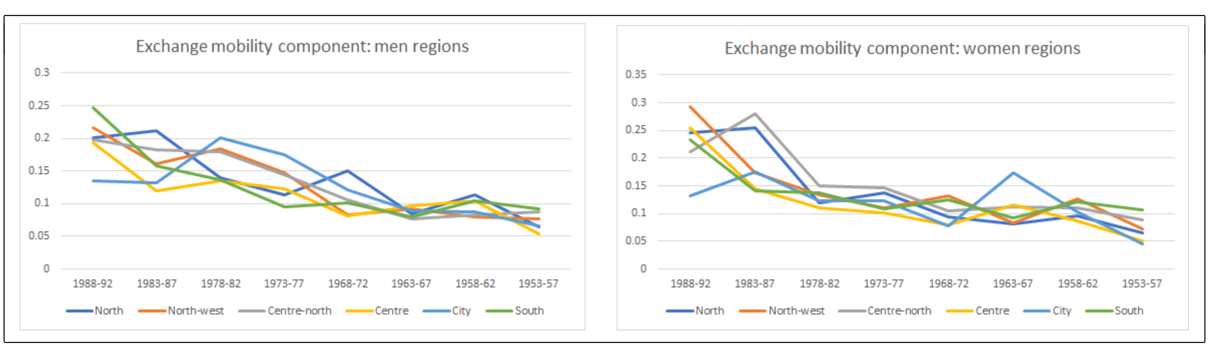


Figure 16: Share of structural mobility component: regional level



Finally, figure 17 shows the regional series of the exchange-mobility component for male and female adults, on the left and right panels respectively. Remarkably, for both men and women the contribution appears concentrated below 10% for the oldest cohort, and then diverges toward younger cohorts: every region experiences increases in the exchange component, but magnitudes vary significantly. For example, in Mexico City the exchange component remains below 15% among the youngest cohort, for both genders. By contrast, the north- west reaches nearly 30% in its exchange component among female younger cohorts. Most region-gender combinations end at about 20-25% in the youngest cohort. In several cases, like the South's (both genders) the exchange mobility component overtakes its structural counterpart in relative contribution toward absolute distributional change.

Figure 17: Share of exchange mobility component: regional level



Tables 8, 10, 12, 14, 16 and 18, in the appendix, show the p-values for two-tailed t-tests of gender differences in absolute panel change A as well as its three components (growth, structural mobility, exchange mobility). Remarkably, but in tune with the national results, none of the gender differences is statistically significant at 10% (except for A in the second-to-oldest cohort in the North).

5.3. Urban-rural status

5.3.1. Preliminary assessment

Figures 18 to 21 show the means and standard deviations of overcrowding at past and present dwellings across cohorts in the four urbanisation groups. The trends are all very similar to those already described for the national and regional cases, with the exception of the urban-to-rural group which is not estimated with appropriate precision. Unsurprisingly, the mean levels of overcrowding at age 14 in the rural-to-urban group are closer to those of the rural-to-rural group than the urban-to-urban's. Likewise, the mean levels of contemporary overcrowding in the rural-to-urban group are closer to those of the urban-to-urban group vis-a-vis the rural-to-rural one. Also, interestingly, for any given cohort-gender combination the differences in current mean overcrowding between urban and rural areas are narrower than those in past mean overcrowding.

Figure 18: Mean and standard deviation: Urban-to-urban

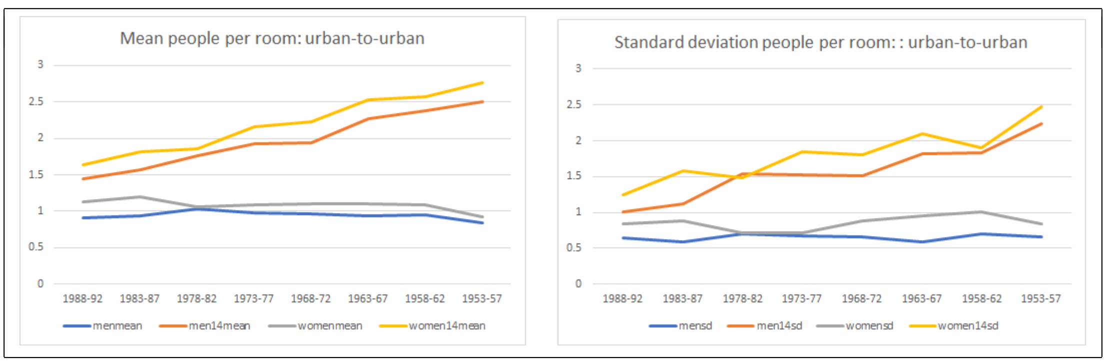


Figure 19: Mean and standard deviation: Rural-to-rural

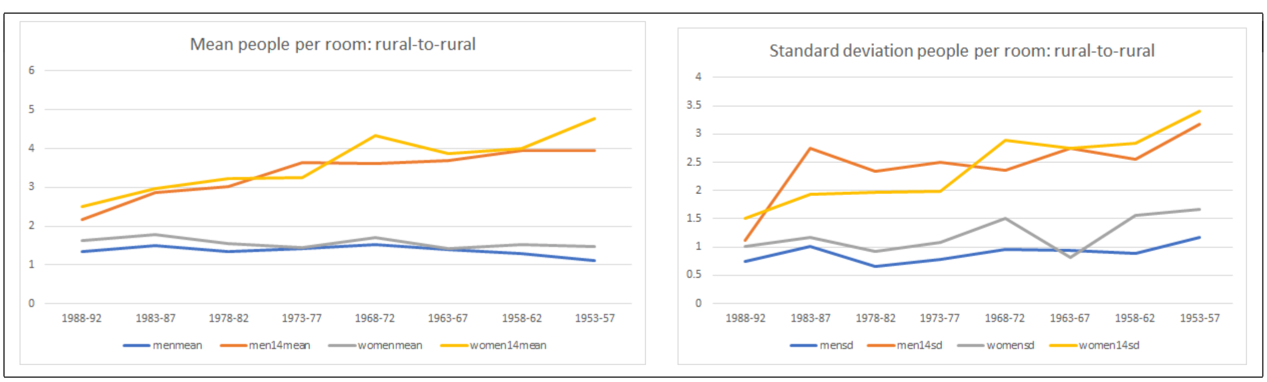


Figure 20: Mean and standard deviation: Rural-to-urban

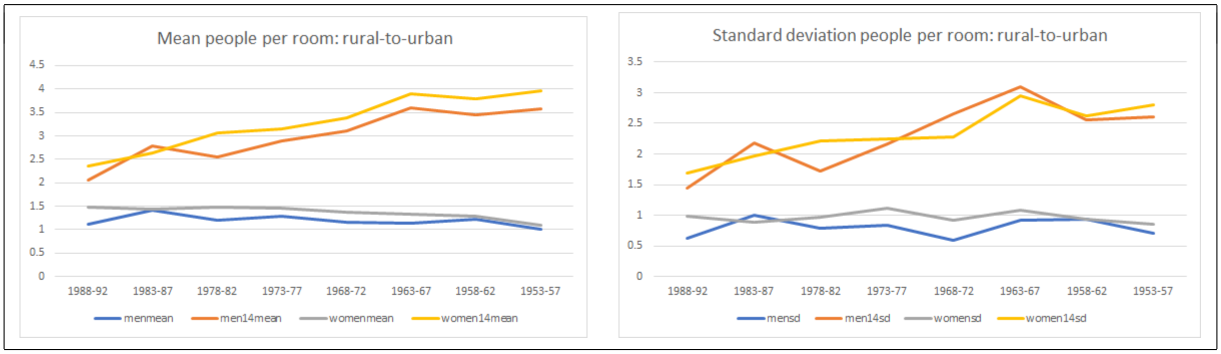
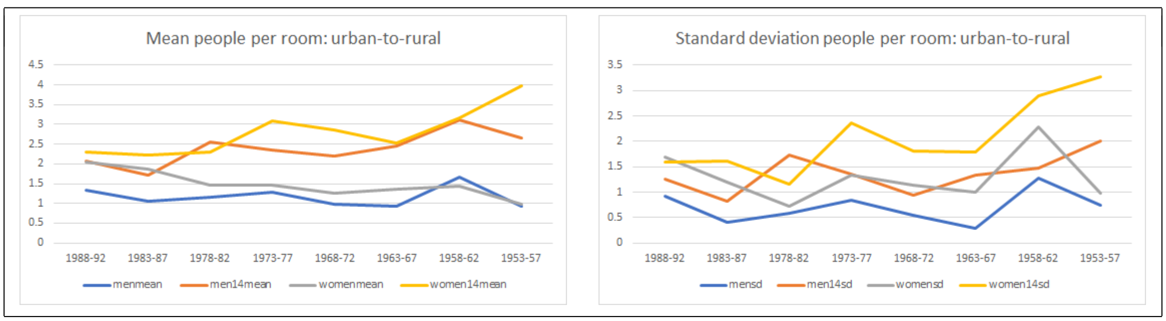


Figure 21: Mean and standard deviation: Urban-to-rural



Tables 19, 21, 23, and 25, in the appendix, show the p-values for two-tailed t-tests of gender differences in current and past (at age 14) mean overcrowding for the four urbanisation groups. Several significant differences appear, especially in current overcrowding levels, but without any major pattern except reflecting relative sample sizes. Thus, we find significant differences at 10% in 13 out of 16 comparisons (8 cohorts times 2 variables) in the urban- to-urban sample, which is the largest of the four; whereas the rural-to-rural sample only features 3 out of 16 comparisons significant at the same level (the Urban-to-rural sample features 2 out of 16 significant differences despite the very small sample sizes involved).

Figure 22 shows the evolution of overcrowding rank correlation across cohorts, gender and urbanisation group. Without being monotonic, a seemingly clear upward trend toward younger cohorts is observed for the urban-to-urban group, less so for the rural-to-urban one and women in the rural-to-rural group. Meanwhile, figure 23 does not reveal any major upward or downward trend in Pearson correlation coefficients of overcrowding, except for mild up- ward trend toward younger cohorts among women in the urban-to-urban and rural-to-rural group.

5.3.2. Joint assessment

Figure 24 shows the trends in absolute panel change across cohorts for men and women in the four urbanisation groups. Several noteworthy features emerge (dismissing the less reliable estimations for the urban-to-rural group): (1) all gender-cohort-urbanisation combinations

Figure 22: Spearman correlation coefficients: urbanisation

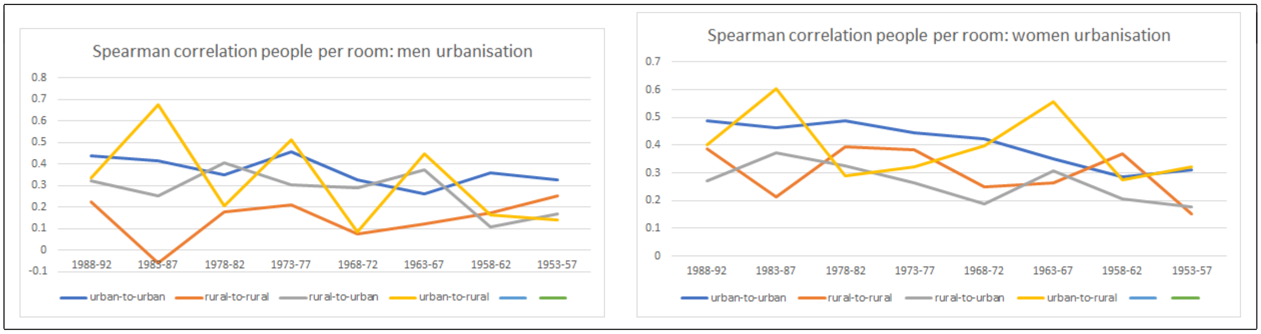
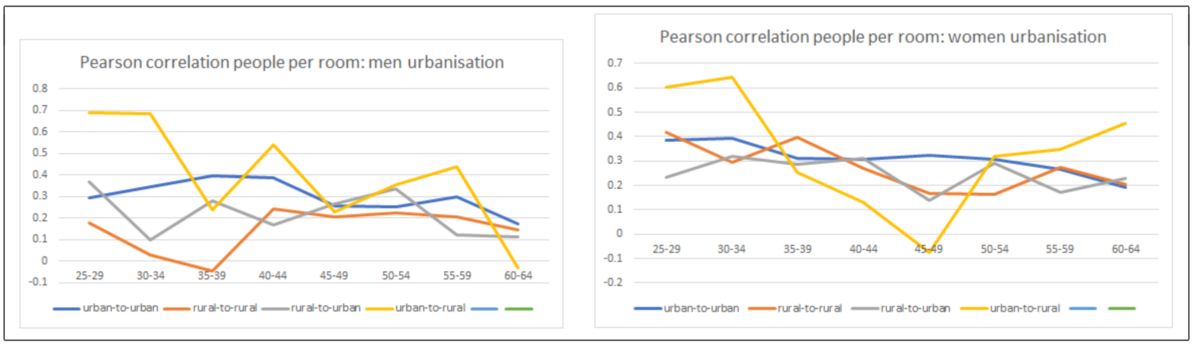


Figure 23: Pearson correlation coefficients: urbanisation



experienced deprivation reduction in overcrowding from a social welfare perspective; (2) older cohorts accrued larger gains; (3) people in the urban-to-urban group enjoyed the smallest improvement; (4) the trends for the rural-to-urban and rural-to-rural groups are remarkably similar, especially among the youngest cohorts.

Figure 24: Absolute distributional change: urbanisation

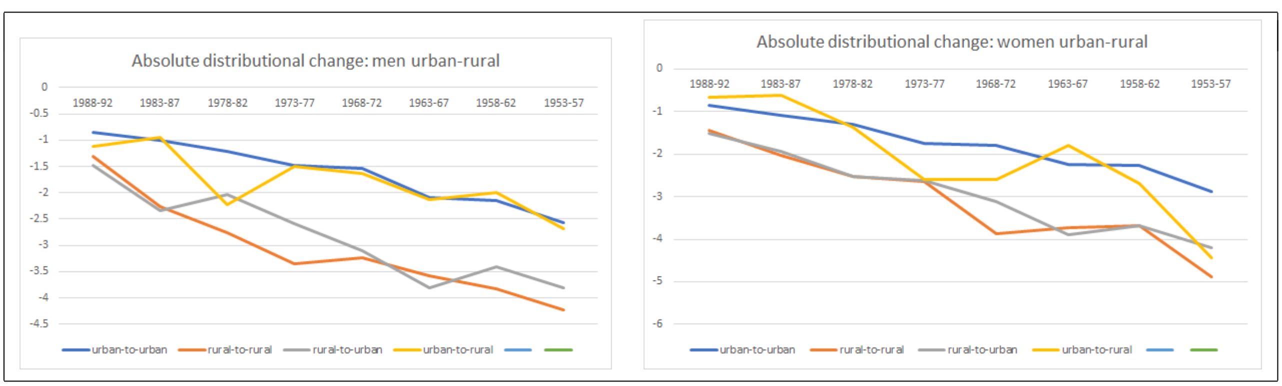


Figure 25 shows the share of the growth component by urbanisation group. Leaving aside the less reliable estimates for the urban-to-rural group, the results corroborate previous findings: that most growth share are around 60% and declining with the youth of the cohort, particularly among women. The trends often cross and overlap across the three groups (urban-to-urban, rural-to-rural and rural-to-urban). In a nutshell, the growth component is confirmed as the main driver of absolute intergenerational reduction in the social evaluation of overcrowding.

Figure 25: Share of growth component: urbanisation

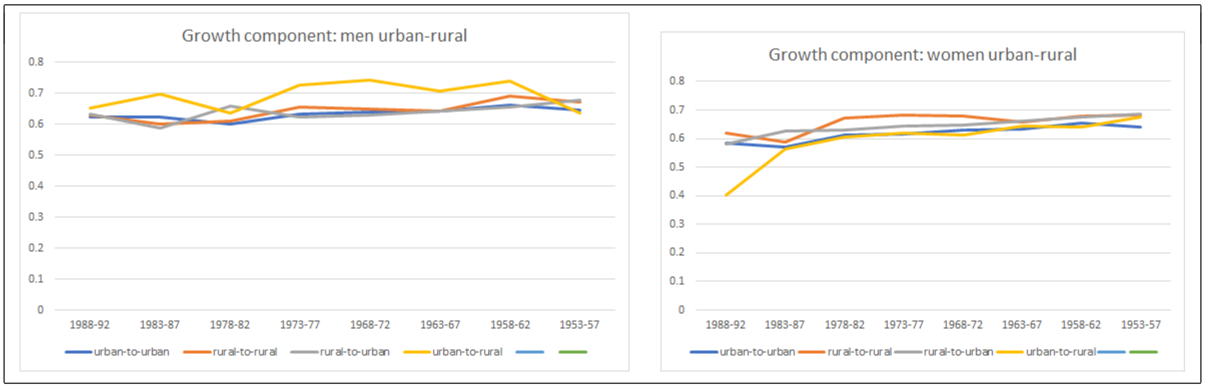
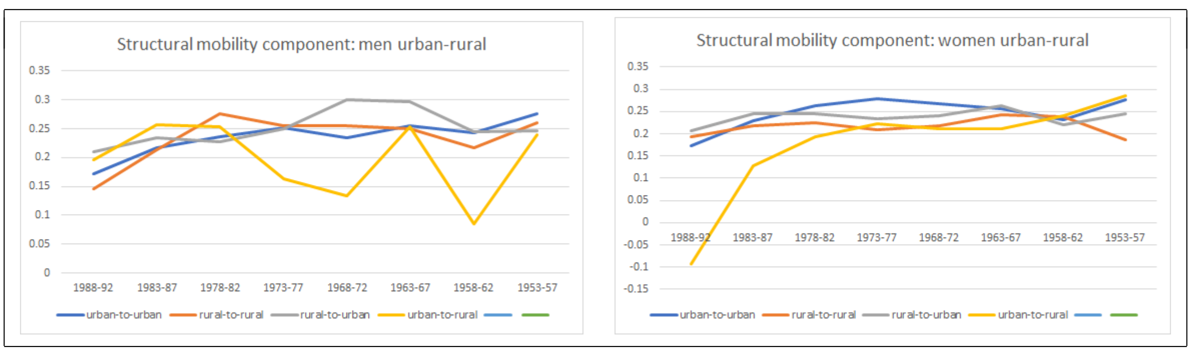


Figure 26 shows the share of the structural mobility component by urbanisation group. Discarding the urban-to-rural group, the results confirm the positive contribution of (anonymous) absolute inequality reduction across generations for all cohort-gender-urbanisation combinations. The trends, again, tend to cross and overlap, but in general the share of the structural mobility component decreases with the youth of the cohort, signalling that the increase in the share of the exchange component is greater than the decrease in the share of the growth component.

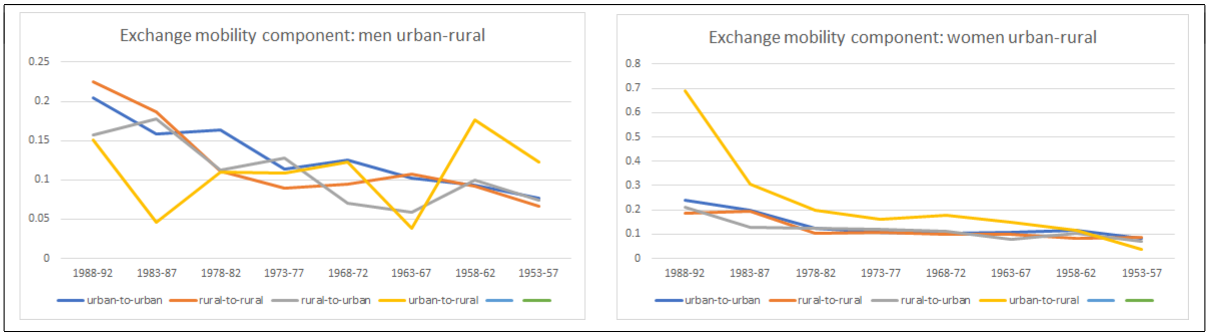
Figure 26: Share of structural mobility component: urbanisation



Finally, figure 27 shows the share of the exchange mobility component by urbanisation group. Again, dismissing the less reliable estimates for the urban-to-rural group, the results show the contributions of exchange mobility increasing with the youth of the cohort, to the point that in some gender-urbanisation combinations (e.g. rural-to-rural men) the exchange mobility component overtakes the structural mobility component as the second most-important driver of absolute panel improvement in overcrowding (after the growth component which remains the main driver throughout).

Tables 20, 22, 24, and 26, in the appendix, show the p-values for two-tailed t-tests of gender differences in absolute panel change A as well as its three components (growth, structural mobility, exchange mobility) for the four urbanisation groups. In tune with the previous results, none of the gender differences is statistically significant at 10%.

Figure 27: Share of exchange mobility component: urbanisation



5.4. Discussion

The above results show improvements in social welfare evaluations of overcrowding across all regions and cohorts. More specifically, the improvements are larger among the older birth cohorts. This is partly explained by initially higher levels of overcrowding at age 14 among the oldest cohorts. Meanwhile, we notice lower Spearman correlation values among the same older cohorts. To what extent can we identify pure cohort effects in these results? In an ideal world we would identify pure birth-cohort effects with the data for people of the same age but born in different years (e.g. all batches of people who were 50 years old in different years; batches of people who were 40 years old in different years; etc.). Likewise, we would identify pure life-cycle effects by following people born in the same year across their lifetime (e.g. everyone born in 1965 followed for several years of their adulthood; everyone born in 1970 followed for several years; and so on). By contrast, we have a cross-section of people born in different years and observed only twice: in 2017 and when they were 14 years old. Therefore, it is difficult to disentangle life-cycle from birth-cohort effects.

However, we can still acquire some helpful knowledge from the results if we apply some elementary reasoning and reasonable assumption to the data. We start by noting that across all regions we find that contemporary mean overcrowding is constant across birth-cohorts. The oldest cohorts might be too young yet for downsizing (if such a route is common among the Mexican elderly) but may have fewer kids living with them as the latter become adults and leave the parental home to form their own families. Meanwhile, the youngest cohorts might have few kids, if any, due to their youth. Hence, we may be better able to detect birth- cohort effects among the intermediate cohorts for whom the number of children, and hence family size, is expected to be significantly more stable (i.e. not many more expected births and offspring too young yet to leave the parental home). Now, among these intermediate birth cohorts we do see higher social welfare improvement among those born earlier in the 20th century. The independence analysis of room number and household size in the next section provides further insights.

6. A mobility assessment of the elements of overcrowding

Now we briefly repeat the two-stage assessment at the national level, but for the numerator and denominator of the overcrowding indicator. The purpose is to derive further insights into the main drivers of the mobility trends in overcrowding. We start with number of rooms, followed by household size.

6.1. Number of rooms

Figure 28 shows the national series of mean overcrowding for the eight cohorts of male and female adults. The labels of the series follow the same logic as those in figure 1.

Several features are worth highlighting. Firstly, mean number of rooms at 14 has been steadily increasing from the oldest cohort to the youngest (albeit not monotonically). In other words, younger cohorts lived in larger houses (though not necessarily less crowded) vis-a-vis older cohorts. Secondly, the current mean number of rooms remains flat for the three oldest cohorts and then declines mildly but monotonically toward the younger cohorts. This may be indicative of a life-cycle effect whereby younger household heads start in smaller homes. By contrast, we do not find any major evidence of downsizing, perhaps signalling that the oldest cohorts are either not yet old enough to justify that move or not used to downsizing in Mexico. Thirdly, we can already notice that the greatest gains in room number accrue to the oldest cohorts. In fact, while the oldest cohorts saw an increase in number of rooms of more than 0.5, the youngest cohort saw a *decline* in room availability (this is without accounting for number of household members!). That is, the two youngest cohorts experienced a loss in mean number of rooms from age 14 to their situation in 2017. Again, this may be revealing a life-cycle effect; but it could also reflect current hardship among the contemporary young in securing larger dwelling. Finally, on average men live in larger homes vis-a-vis women.

Figure 28: Mean number of rooms: national level

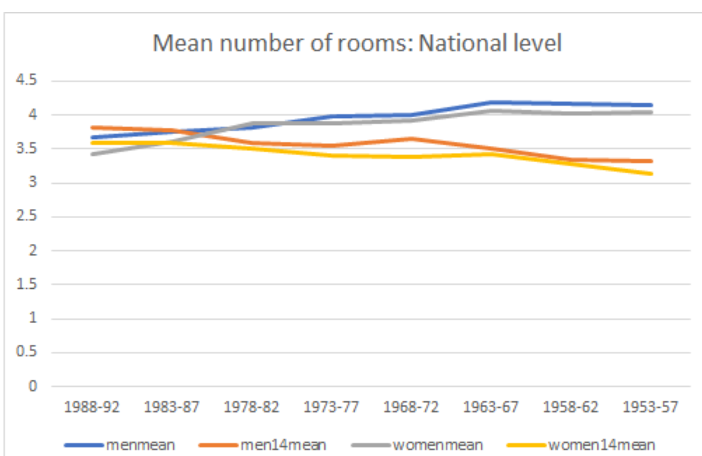


Figure 29 shows the national series for the standard deviation of number of rooms for the eight cohorts of both genders. Labels work as in figure 2. We note that the current standard deviation is relatively stable across cohorts, varying not far from 1.5, and almost overlapping across genders, although the oldest cohorts exhibit higher absolute dispersion in number of rooms. Meanwhile, the standard deviation of overcrowding at 14 has also remained relatively stable, but mildly decreasing with the youth of the cohorts. In every cohort-gender combination, absolute inequality as measured by the standard deviation is lower than it was when people were 14 years old.

Figure 29: Standard deviations: national level

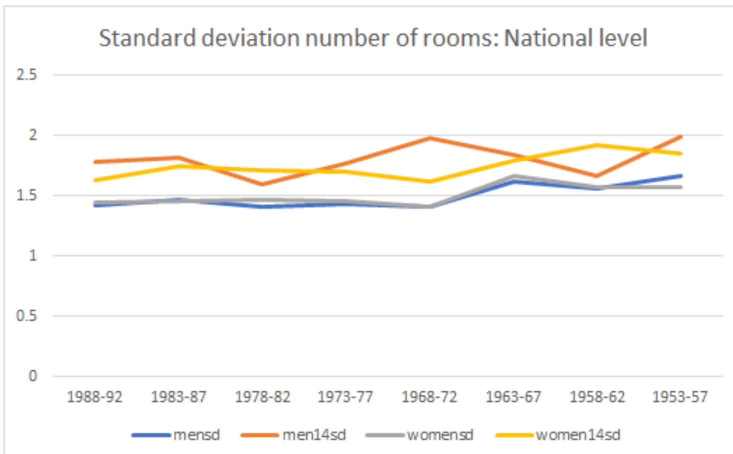


Figure 30 shows the national series for the Spearman rank-correlation coefficient and Pearson product-moment correlation coefficient, both linking current number of rooms with the levels at 14, computed for each male and female cohort. The Spearman series show increasing trends for men and fluctuating trends for women (without any marked downward or upward direction). The Pearson series largely concur with similar trends.

Figure 30: Spearman and Pearson correlations: national level

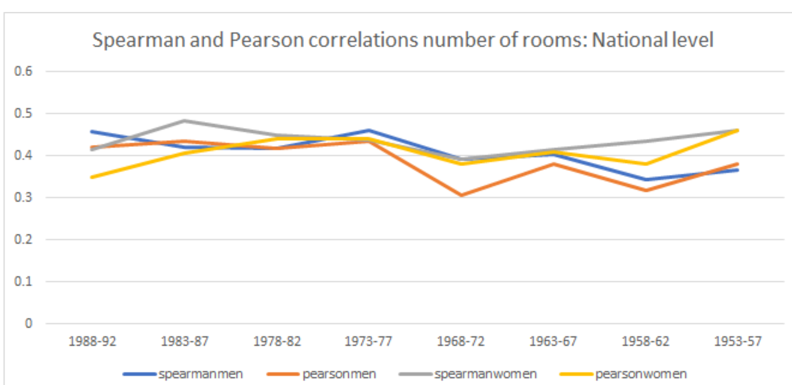


Figure 31 shows the national series for the measure of social welfare (since a higher number of rooms is deemed better), $A(\Delta X)$ with $x_1(1)x_1(2) \geq \cdots \geq x_1(n)$ (so the wellbeing of people being 14 years old in houses with fewer rooms receives higher weight), for male and female adults. Since these measures are differences of weighted averages, their units are also number of rooms.

Several features are noteworthy. Firstly, all cohorts, male and female, experienced improvement in the welfare measure. Secondly, older cohorts experienced the largest gains. In fact, weighted number of rooms increased by more than 1.4 for the oldest cohort, whereas it increased by a mere 0.4 for the youngest cohort. Note that these improvement values are greater than those that could be deduced from figure 28 (looking at mean improvements); hence suggesting pro-poor growth. In fact, as we know from figure 28, the change in mean number of rooms is negative for the youngest cohorts of men and women. However, the measure of absolute distributional change W turns out positive because of the greater contribution of inequality reduction even among the youngest.

Figure 31: Absolute distributional change: national level

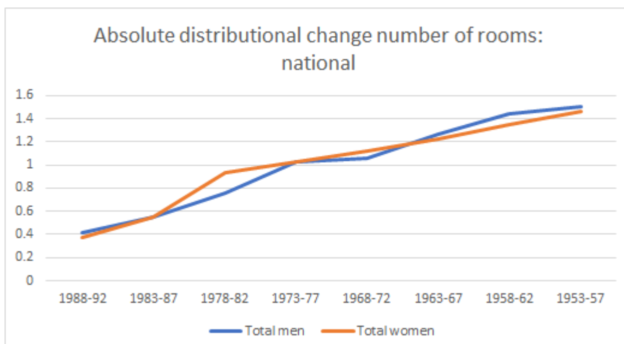


Figure 32 shows the decomposition of A with $\beta(i;\ 2, n)$, for the national sample of male and female adults. Perhaps the most salient feature is the decrease in the contribution of the growth component as we move from older to younger cohorts (for both genders). While the growth component explains more than half of the welfare gains among the top two oldest cohorts, it is either tiny or even negative among the two youngest cohorts. The other side of the coin is the increase in the relative role of the inequality component among the younger cohorts driven mainly by exchange mobility. Finally, structural mobility further increases social welfare but with a smaller contribution.

6.2. Household size

Figure 33 shows the national series of mean overcrowding for the eight cohorts of male and female adults. The labels of the series follow the same logic as those in figure 1.

Several features are worth highlighting. Firstly, current household size (operationalised by the number of people who share food in the same home) remains stable at about 4 people for women (and slightly less for men) across cohorts. Only the extreme birth-cohorts have fewer members of on average, which seems to reflect a life-cycle effects: the youngest household heads have fewer children (if any) and the oldest are more likely to have adult children who already left the parental home (plus potentially higher rates of deceased spouses). Secondly, for both genders, household size at age 14 is relatively flat at above 7 people for the three oldest cohorts, but then monotonically decreases towards the young, reaching 5 people among men of the youngest cohort. Thus, we can already note that the greatest gains in average size reduction accrue to the oldest cohorts. With higher confidence, we can attribute this gain trajectory to cohort effects if we focus on the birth-cohorts away from the extremes. Finally, across the board, women belong in households with more members on average.

Figure 32: Growth, structural and exchange mobility components: national level

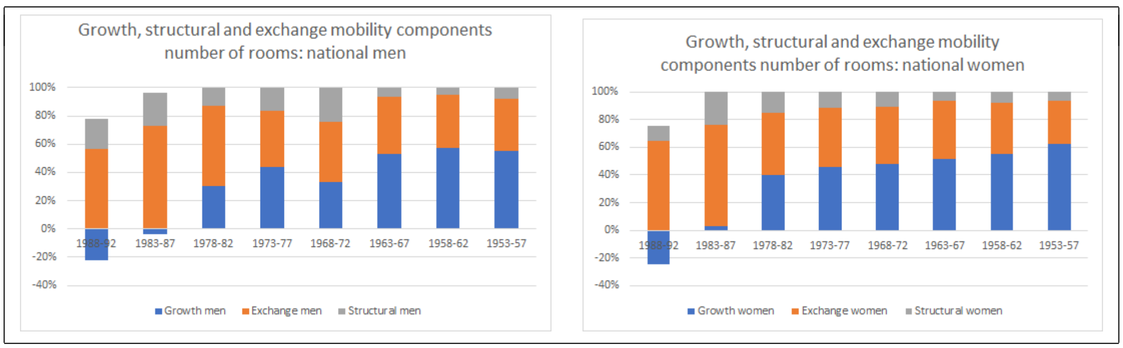


Figure 33: Mean household size: national level

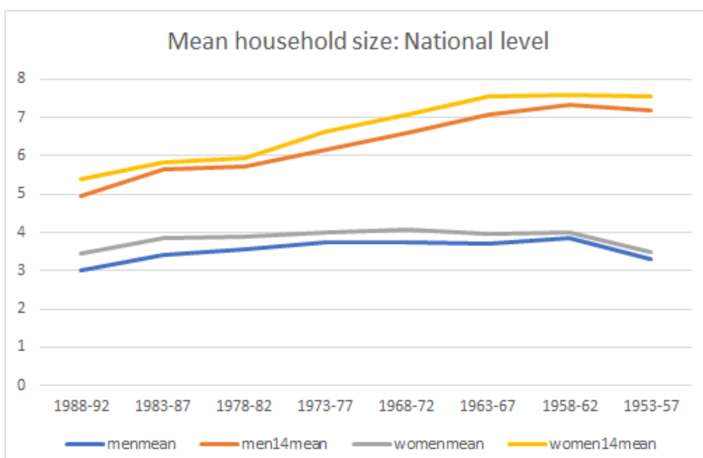


Figure 34 shows the national series for the standard deviation of number of rooms for the eight cohorts of both genders. Labels work as in figure 2. We note that both the current standard deviation and that for household size at 14 have been declining from older to younger cohorts, albeit not always monotonically. We should then expect a positive contribution of structural mobility toward reduced social deprivation (as measured by A).

Figure 35 shows the national series for the Spearman rank-correlation coefficient and Pearson product-moment correlation coefficient, both linking current household size with the levels at 14, computed for each male and female cohort. The Spearman series show increasing trends especially for women (less so for men), thereby signalling a reduction in rank mobility (although no cohort ever experiences a value of 0.3, let alone higher). The Pearson series concur with similar trends, although showing a more marked increasing trend for men (less relative mobility as measured by the Pearson product-moment correlation coefficient). The increases are not monotonic for all four series.

Figure 34: Standard deviations: national level

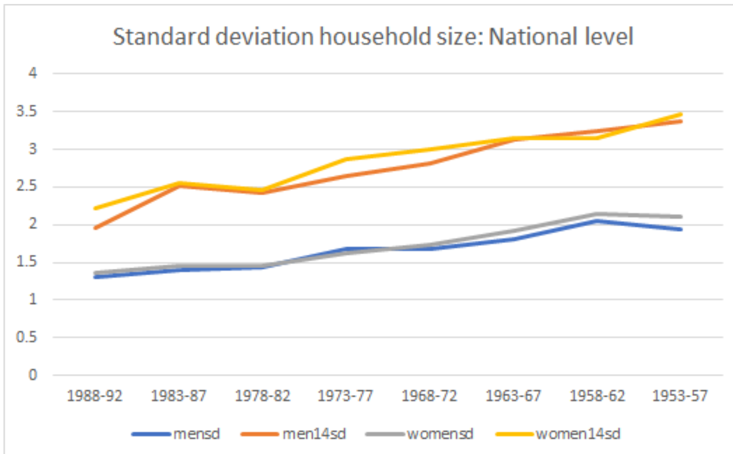


Figure 35: Spearman and Pearson correlations: national level

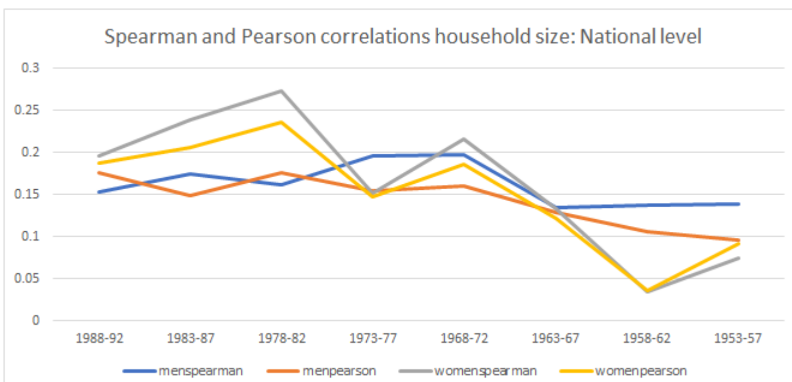


Figure 36 shows the national series for the measure of social destitution, A with $\beta(i;\ 2, n)$, for male and female adults. Since these measures are differences of weighted averages, their units are also number of people. The reader is made aware that the assessment assumes that large household sizes are negative, hence attributing higher weight to the wellbeing of people living in households initially larger when they were 14 years old. This is admittedly a controversial assumption, as one could also put forward arguments to favour increases in household size. However, in the context of developing countries where several poor families are characterised by large sizes, one can defend prioritising size reductions among those initially living in larger households and giving a positive valuation to such reductions in general.

Several features are noteworthy. Firstly, all cohorts, male and female, experienced welfare improvement from household size reduction. Secondly, older cohorts experienced the largest gains (larger absolute values). In fact, weighted household size decreased by nearly 6 people for the oldest cohort, whereas it went down by about 3 people for the youngest cohort. Note that these improvement values are greater than those that could be deduced from figure 33 (looking at mean reductions); hence suggesting pro-poor growth.

Figure 36: Absolute distributional change: national level

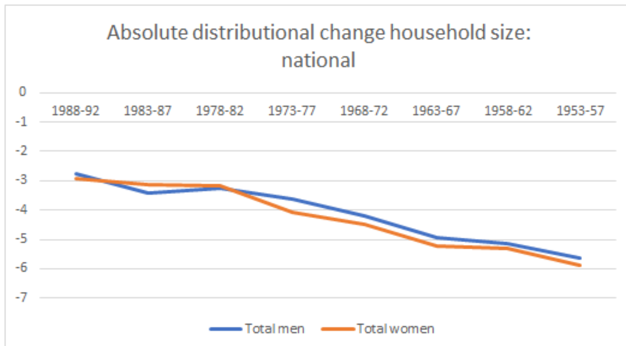
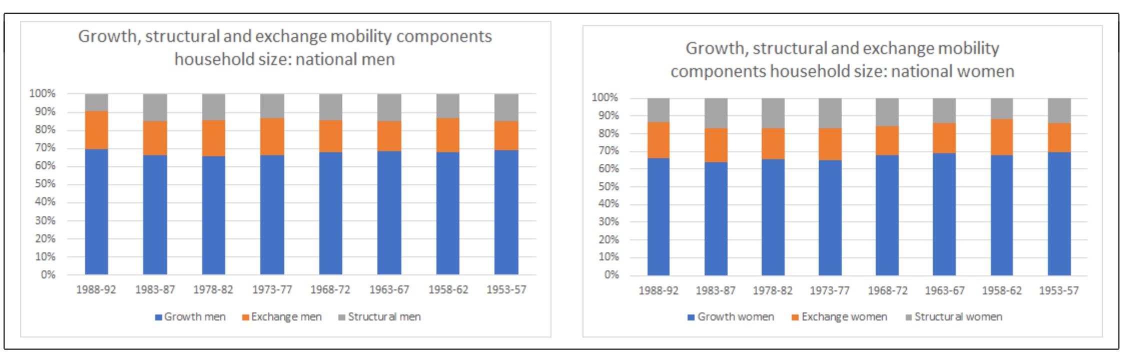


Figure 37 shows the decomposition of A with $\beta(i;\ 2, n)$, for the national sample of male and female adults. Firstly, we note that across cohorts the main driver of social welfare improvement is the mean decrease in household size (just as in the case of overcrowding), explaining at least 60% of the decrease in the social destitution measure across the board (in general larger contributions than in the case of overcrowding). Secondly, the remainder 30-40 % in welfare gain is provided by inequality reduction. Hence, we can conclude that reduction in household size among both male and female adults was pro-poor at the national level. Thirdly, unlike the case of overcrowding, there is no clear role reversal in the contributions of structural and exchange mobility. If anything, exchange mobility is slightly more important across almost every gender-cohort combination.

Figure 37: Growth, structural and exchange mobility components: national level



7. Concluding remarks

The welfare-based assessment of absolute distributional change led us to conclude that a large proportion of welfare improvement in Mexico (around 60% in most cases) was due to average increase in the number of rooms per person. Additionally, inequality reduction in overcrowding brought further welfare improvement. This was mainly led by structural mobility, except among the younger cohorts where exchange mobility prevailed as the main driver of pro-poor overcrowding relief (as opposed to distribution-neutral relief).

Why does exchange mobility gain prominence among younger cohorts within the inequality component? Is it related to the smaller scope for further reduction given the lower initial mean overcrowding levels for this cohort? Outstanding questions like the latter further invite deeper research into at least three areas. Firstly, analyses of social mobility where life-cycle effects can be separated from cohort effects. People's housing prospects depend on a combination of family background and date of birth (cohort effects), but many also change accommodation along their lifetime (for different reasons, but usually ”upsizing” from young-adulthood to middle-age or ”downsizing” from middle-age to retirement age). Therefore, it would be ideal to be able to separate cohort effects from life-cycle behaviour (and the interactions thereof). In fact, the distinction between cohort- and life-cycle effects has long been identified and documented in several economic phenomena, at least since Shorrocks (1975). However, the data requirements may be daunting: long panel datasets with adequate retrospective questions (when adults are not followed from childhood). As mentioned in the discussion section, ideally we would have data for people of the same age but born in different years in order to identify pure birth-cohort effects, whereas we would follow people born in the same year across different points in their lives in order to identify pure life-cycle effects.

Secondly, future research could also look into the age gap between parents and offspring in order to test any social mobility differentials based on the lifecycle of the parents. This would be a relevant hypothesis to test, especially if we could spot differences in the material conditions of a 14-year-old living with parents in their 30s vis-a-vis a cohort peer living with parents in their 50s, for instance.

Thirdly, future research should aim to clarify the relative contributions of higher quantity of rooms vis-a-vis smaller family sizes to the observed welfare improvements in overcrowding in Mexico. This line of inquiry is easier to pursue from the point of view of data requirements, but may require methodological refinements in the form of a welfare decomposition that relates changes in a ratio indicator of wellbeing (e.g. overcrowding) to distributional changes (i.e. not just mean change) in both the numerator and denominator. We already gained some indicative knowledge by performing the national analysis for the numerator (number of rooms) and denominator (household members) separately. We found evidence of positive contributions from both increased welfare based on number of rooms and decreased deprivation based on household size. We are confident that genuine birth-cohort effects can be identified if we dismiss the extreme birth cohorts (which exhibit lower household sizes possibly due to life-cycle effects). Overall, reductions in overcrowding in Mexico among the youngest cohorts (1) are not a mere artefact of the life cycle and the data collection method; (2) from a social welfare perspective encompass mainly mean reduction but also structural and exchange mobility; and (3) reflect related welfare gains both in the numerator (number of rooms) and denominator (number of people).

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8. Appendix: T-tests for gender differences in measures of absolute panel change in overcrowding

8.1. National level

Table 5: T-tests for gender differences in current and past mean overcrowding (p-values)

	Current overcrowding	Overcrowding at age 14
1988 - 1992	0.000	0.000
1983 - 1987	0.000	0.033
1978 - 1982	0.004	0.007
1973 - 1977	0.000	0.004
1968 - 1972	0.000	0.001
1963 - 1967	0.000	0.012
1958 - 1962	0.029	0.057
1953 - 1957	0.004	0.000

Table 6: T-tests for gender differences in absolute panel change in overcrowding and its components (p-values)

	$A(\Delta X, 2)$	$\Delta \bar{x}$	$I(\Delta Y_2 X_1, 2)$	$I(\Delta X_2 Y_2, 2)$
1988 - 1992	0.531	0.968	0.769	0.484
1983 - 1987	0.879	0.628	0.954	0.708
1978 - 1982	0.196	0.129	0.424	0.837
1973 - 1977	0.190	0.146	0.578	0.693
1968 - 1972	0.118	0.056	0.610	0.602
1963 - 1967	0.339	0.243	0.855	0.497
1958 - 1962	0.430	0.337	0.866	0.640
1953 - 1957	0.032	0.007	0.494	0.557

8.2. Regional level

8.2.1. North

Table 7: T-tests for gender differences in current and past mean overcrowding (p-values)

	Current overcrowding	Overcrowding at age 14
1988 - 1992	0.000	0.557
1983 - 1987	0.000	0.447
1978 - 1982	0.304	0.391
1973 - 1977	0.223	0.760
1968 - 1972	0.390	0.012
1963 - 1967	0.417	0.559
1958 - 1962	0.488	0.013
1953 - 1957	0.412	0.211

Table 8: T-tests for gender differences in absolute panel change in overcrowding and its components (p-values)

	$A(\Delta X, 2)$	$\Delta\bar{x}$	$I(\Delta Y_2 X_1, 2)$	$I(\Delta X_2 Y_2, 2)$
1988 - 1992	0.741	0.455	0.997	0.830
1983 - 1987	0.779	0.374	0.635	0.907
1978 - 1982	0.567	0.589	0.684	0.947
1973 - 1977	0.813	0.822	0.736	0.826
1968 - 1972	0.063	0.030	0.285	0.849
1963 - 1967	0.770	0.724	0.879	0.976
1958 - 1962	0.054	0.025	0.343	0.763
1953 - 1957	0.203	0.151	0.525	0.655

8.2.2. North-west

Table 9: T-tests for gender differences in current and past mean overcrowding (p-values)

	Current overcrowding	Overcrowding at age 14
1988 - 1992	0.000	0.799
1983 - 1987	0.000	0.137
1978 - 1982	0.776	0.125
1973 - 1977	0.051	0.042
1968 - 1972	0.006	0.246
1963 - 1967	0.139	0.091
1958 - 1962	0.014	0.486
1953 - 1957	0.126	0.244

Table 10: T-tests for gender differences in absolute panel change in overcrowding and its components (p-values)

	$A(\Delta X, 2)$	$\Delta\bar{x}$	$I(\Delta Y_2 X_1, 2)$	$I(\Delta X_2 Y_2, 2)$
1988 - 1992	0.097	0.090	0.458	0.874
1983 - 1987	0.782	0.935	0.767	0.890
1978 - 1982	0.113	0.100	0.358	0.959
1973 - 1977	0.311	0.231	0.446	0.888
1968 - 1972	0.932	0.950	0.840	0.564
1963 - 1967	0.429	0.225	0.859	0.937
1958 - 1962	0.996	0.785	0.898	0.530
1953 - 1957	0.682	0.454	0.957	0.989

8.2.3. Centre-north

Table 11: T-tests for gender differences in current and past mean overcrowding (p-values)

	Current overcrowding	Overcrowding at age 14
1988 - 1992	0.000	0.089
1983 - 1987	0.000	0.274
1978 - 1982	0.041	0.048
1973 - 1977	0.750	0.589
1968 - 1972	0.010	0.031
1963 - 1967	0.025	0.925
1958 - 1962	0.508	0.698
1953 - 1957	0.187	0.017

Table 12: T-tests for gender differences in absolute panel change in overcrowding and its components (p-values)

	$A(\Delta X, 2)$	$\Delta\bar{x}$	$I(\Delta Y_2 X_1, 2)$	$I(\Delta X_2 Y_2, 2)$
1988 - 1992	0.225	0.790	0.346	0.653
1983 - 1987	0.898	0.512	0.810	0.470
1978 - 1982	0.352	0.341	0.633	0.974
1973 - 1977	0.884	0.712	0.875	0.935
1968 - 1972	0.219	0.210	0.546	0.713
1963 - 1967	0.533	0.384	0.602	0.682
1958 - 1962	0.535	0.527	0.485	0.832
1953 - 1957	0.133	0.053	0.580	0.639

8.2.4. Centre

Table 13: T-tests for gender differences in current and past mean overcrowding (p-values)

	Current overcrowding	Overcrowding at age 14
1988 - 1992	0.000	0.011
1983 - 1987	0.000	0.551
1978 - 1982	0.013	0.573
1973 - 1977	0.035	0.014
1968 - 1972	0.037	0.147
1963 - 1967	0.192	0.162
1958 - 1962	0.762	0.164
1953 - 1957	0.851	0.281

Table 14: T-tests for gender differences in absolute panel change in overcrowding and its components (p-values)

	$A(\Delta X, 2)$	$\Delta\bar{x}$	$I(\Delta Y_2 X_1, 2)$	$I(\Delta X_2 Y_2, 2)$
1988 - 1992	0.587	0.775	0.426	0.726
1983 - 1987	0.922	0.810	0.760	0.769
1978 - 1982	0.450	0.498	0.855	0.602
1973 - 1977	0.075	0.098	0.263	0.912
1968 - 1972	0.520	0.434	0.788	0.901
1963 - 1967	0.270	0.386	0.505	0.533
1958 - 1962	0.260	0.189	0.476	0.986
1953 - 1957	0.367	0.283	0.651	0.860

8.2.5. South

Table 15: T-tests for gender differences in current and past mean overcrowding (p-values)

	Current overcrowding	Overcrowding at age 14
1988 - 1992	0.000	0.015
1983 - 1987	0.000	0.433
1978 - 1982	0.244	0.063
1973 - 1977	0.147	0.389
1968 - 1972	0.076	0.129
1963 - 1967	0.016	0.117
1958 - 1962	0.234	0.632
1953 - 1957	0.000	0.003

Table 16: T-tests for gender differences in absolute panel change in overcrowding and its components (p-values)

	$A(\Delta X, 2)$	$\Delta\bar{x}$	$I(\Delta Y_2 X_1, 2)$	$I(\Delta X_2 Y_2, 2)$
1988 - 1992	0.478	0.568	0.669	0.834
1983 - 1987	0.612	0.657	0.841	0.681
1978 - 1982	0.387	0.183	0.983	0.678
1973 - 1977	0.804	0.818	0.983	0.723
1968 - 1972	0.628	0.531	0.815	0.589
1963 - 1967	0.716	0.493	0.802	0.681
1958 - 1962	0.959	0.894	0.861	0.798
1953 - 1957	0.249	0.148	0.892	0.344

8.2.6. Mexico City

Table 17: T-tests for gender differences in current and past mean overcrowding (p-values)

	Current overcrowding	Overcrowding at age 14
1988 - 1992	0.000	0.081
1983 - 1987	0.000	0.896
1978 - 1982	0.733	0.980
1973 - 1977	0.332	0.344
1968 - 1972	0.091	0.090
1963 - 1967	0.299	0.948
1958 - 1962	0.707	0.346
1953 - 1957	0.625	0.144

Table 18: T-tests for gender differences in absolute panel change in overcrowding and its components (p-values)

	$A(\Delta X, 2)$	$\Delta\bar{x}$	$I(\Delta Y_2 X_1, 2)$	$I(\Delta X_2 Y_2, 2)$
1988 - 1992	0.493	0.285	0.989	0.887
1983 - 1987	0.538	0.697	0.531	0.815
1978 - 1982	0.523	0.840	0.993	0.534
1973 - 1977	0.382	0.659	0.327	0.877
1968 - 1972	0.163	0.208	0.392	0.840
1963 - 1967	0.758	0.537	0.605	0.511
1958 - 1962	0.471	0.435	0.800	0.712
1953 - 1957	0.115	0.098	0.346	0.963

8.3. Urbanisation

8.3.1. Urban-to-urban

Table 19: T-tests for gender differences in current and past mean overcrowding (p-values)

	Current overcrowding	Overcrowding at age 14
1988 - 1992	0.000	0.005
1983 - 1987	0.000	0.006
1978 - 1982	0.633	0.281
1973 - 1977	0.014	0.019
1968 - 1972	0.006	0.007
1963 - 1967	0.001	0.045
1958 - 1962	0.051	0.178
1953 - 1957	0.069	0.046

Table 20: T-tests for gender differences in absolute panel change in overcrowding and its components (p-values)

	$A(\Delta X, 2)$	$\Delta\bar{x}$	$I(\Delta Y_2 X_1, 2)$	$I(\Delta X_2 Y_2, 2)$
1988 - 1992	0.935	0.699	0.954	0.655
1983 - 1987	0.607	0.883	0.736	0.493
1978 - 1982	0.522	0.369	0.562	0.572
1973 - 1977	0.104	0.154	0.304	0.775
1968 - 1972	0.146	0.149	0.294	0.938
1963 - 1967	0.471	0.491	0.760	0.659
1958 - 1962	0.615	0.673	0.957	0.577
1953 - 1957	0.213	0.153	0.580	0.628

8.3.2. Rural-to-rural

Table 21: T-tests for gender differences in current and past mean overcrowding (p-values)

	Current overcrowding	Overcrowding at age 14
1988 - 1992	0.147	0.216
1983 - 1987	0.181	0.808
1978 - 1982	0.155	0.550
1973 - 1977	0.935	0.241
1968 - 1972	0.380	0.075
1963 - 1967	0.905	0.700
1958 - 1962	0.364	0.915
1953 - 1957	0.066	0.062

Table 22: T-tests for gender differences in absolute panel change in overcrowding and its components (p-values)

	$A(\Delta X, 2)$	$\Delta\bar{x}$	$I(\Delta Y_2 X_1, 2)$	$I(\Delta X_2 Y_2, 2)$
1988 - 1992	0.731	0.790	0.606	0.927
1983 - 1987	0.778	0.681	0.944	0.924
1978 - 1982	0.741	0.990	0.663	0.835
1973 - 1977	0.281	0.222	0.441	0.933
1968 - 1972	0.357	0.191	0.947	0.792
1963 - 1967	0.856	0.726	0.978	0.939
1958 - 1962	0.860	0.740	0.927	0.897
1953 - 1957	0.433	0.283	0.659	0.678

8.3.3. Rural-to-urban

Table 23: T-tests for gender differences in current and past mean overcrowding (p-values)

	Current overcrowding	Overcrowding at age 14
1988 - 1992	0.000	0.128
1983 - 1987	0.909	0.518
1978 - 1982	0.008	0.021
1973 - 1977	0.067	0.207
1968 - 1972	0.008	0.227
1963 - 1967	0.073	0.325
1958 - 1962	0.405	0.201
1953 - 1957	0.175	0.059

Table 24: T-tests for gender differences in absolute panel change in overcrowding and its components (p-values)

	$A(\Delta X, 2)$	$\Delta\bar{x}$	$I(\Delta Y_2 X_1, 2)$	$I(\Delta X_2 Y_2, 2)$
1988 - 1992	0.953	0.736	0.994	0.595
1983 - 1987	0.355	0.485	0.760	0.379
1978 - 1982	0.168	0.242	0.421	0.592
1973 - 1977	0.909	0.676	0.883	0.917
1968 - 1972	0.977	0.768	0.554	0.311
1963 - 1967	0.884	0.692	0.743	0.657
1958 - 1962	0.590	0.332	0.947	0.840
1953 - 1957	0.297	0.130	0.674	0.930

8.3.4. Urban-to-rural

Table 25: T-tests for gender differences in current and past mean overcrowding (p-values)

	Current overcrowding	Overcrowding at age 14
1988 - 1992	0.176	0.655
1983 - 1987	0.029	0.328
1978 - 1982	0.141	0.512
1973 - 1977	0.555	0.219
1968 - 1972	0.505	0.330
1963 - 1967	0.098	0.890
1958 - 1962	0.775	0.958
1953 - 1957	0.874	0.114

Table 26: T-tests for gender differences in absolute panel change in overcrowding and its components (p-values)

	$A(\Delta X, 2)$	$\Delta\bar{x}$	$I(\Delta Y_2 X_1, 2)$	$I(\Delta X_2 Y_2, 2)$
1988 - 1992	0.367	0.299	0.410	0.485
1983 - 1987	0.545	0.410	0.690	0.739
1978 - 1982	0.332	0.160	0.570	0.927
1973 - 1977	0.179	0.399	0.413	0.563
1968 - 1972	0.252	0.643	0.495	0.618
1963 - 1967	0.718	0.492	0.754	0.677
1958 - 1962	0.542	0.785	0.421	0.967
1953 - 1957	0.220	0.105	0.460	0.764