Title: How Does Internal Migration Impact the Fertility Behaviour of Individuals? An Analysis Across the Global South.

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Abstract

The fertility behaviour of migrants has long been contested. Many studies concluded that migrants have different fertility than non-migrants through socialisation, adaptation, selection and disruption hypotheses. These hypotheses are validated through different country-specific and regional studies, but there lack systematic and macroscopic studies that test them and contextualise their applicability. This study intends to fill this gap in our understanding of migrants' fertility, by employing newly available microcensus data with detailed fertility and migratory information, coupled with time-varying urban hierarchy classification. The result suggests that younger migrants are slightly selective toward destination fertility prior migration and adopt to destination fertility post migration to different magnitude depending on migratory flow. The older migrants have similar fertility as their origin when moving down the urban hierarchy, and more selective towards destination fertility when moving up. This study shows that socialisation, adaptation and selection hypothesis are each applicable for certain flows and migrants, and we did not observe disruption hypothesis.

Keywords – Fertility, Internal Migration, Global South

Introduction

The total fertility rate (TFR), measuring the lifetime live births per woman, has fallen from 5 in 1960s to 2.2 in 2024, and is expected to further decline to 2.1 in 2050, reaching the replacement fertility level, at which a population replaces itself and remain at the same size over time (United Nations, 2025). This general decline aligns with the patterns of fertility transition within the demographic transition theory. In the pre-transition phase, the fertility remains relatively high at 6 to 7 children per woman; over the fertility transition, the fertility declines to replacement level or below; in the post-transition phase, the fertility remains low at around replacement level (Alkema et al., 2011; United Nations, 2025; Zelinsky, 1971).

Fertility can indirectly impact the economic growth of a society, as it is crucial for shaping future population structure and workforce sustainability (Alkema et al., 2011; Williamson, 2013). Overall, fertility has a negative but non-causal correlation with economic growth (The World Bank, 2010). In developing countries, the initial increase in life expectancy, decline in fertility, and lowering in youth dependency ratio drove economic growth, as evidenced by East Asian countries, where this demographic pattern accounted for up to one third of GDP per capita growth between 1965 and 1990 (Bloom & Finlay, 2009; Bloom & Williamson, 1998). More specifically, in a society characterized by high fertility and low infant mortality, the initially large dependent young population can restrain economic growth; as this young population enters the workforce, the economic growth accelerates and peaks as a result of delayed fertility decline; eventually, aging and retirement reduce the working-age population, slowing the economic growth again (Williamson, 2013). On the other hand, economic conditions can also shift fertility behaviour to a certain extent. Studies have found that higher income levels are generally linked to lower fertility rates, both within and across countries, and this negative relationship only weakens after the completion of fertility transition (Doepke et al., 2023). Galor (2012) argues that the declining fertility over economic growth is mainly due to demand for human capital during development. This complex interactions between fertility and economy highlight the importance of considering fertility patterns and behaviours in planning for economic development policies.

Population dynamic is a result of complex interactions between fertility, life expectancy and migration (United Nations, 2025). In the urban contexts, migration plays a significant role in urban population growth in early

demographic and mobility transition, and its contribution decreases as the transitions proceed, where natural increase becomes more dominant (Jiang & O'Neill, 2018). Towards the later stages of transitions, which is characterized by low fertility rate, encouraging migration becomes more crucial for slowing down population decline, instead of trying to increase fertility level of local population (United Nations, 2025). Despite the growing importance of migration in demographic studies, it remains secondary to research on fertility and mortality (Skeldon, 2021). This paper aims to fill this gap in literature by testing the existing hypotheses on fertility of migrants across different internal development contexts, focusing primarily on countries in the Global South. This paper explores the relationship between population, development and geography, and it can help design policies for achieving 2030 Agenda for Sustainable Development (United Nations, 2015).

Literature Review

Different countries are in different stages of fertility transition. In Europe and North America, the transition completed by mid-20th century; many countries in Latin America and East Asia started the transition in late 20th century and most of them completed the transition by 2024; other countries are in different stages of the fertility transition, but all countries have entered in by 2024 (United Nations, 2025). As of 2010-16, developing countries with the highest fertility rate were concentrated in sub-Sahara Africa and Afghanistan, and the lowest in Latin America, North Africa and Southeast Asia (Pezzulo et al., 2021). Areas with high fertility are characterized by low education level, low use of contraception, and unmet needs for family planning (Pezzulo et al., 2021; The World Bank, 2010). The subsequent fertility transition is likely due to reducing socioeconomic benefits of large families due to lower child mortality and high costs of raising children (United Nations, 2025). At sub-national level, several country-specific and internationally comparative studies have shown that the fertility level falls continuously from big cities to rural areas due to rural-urban differences in education, income, job opportunities, the cost of raising children and social values (Goldstein & Goldstein, 1981; Hugo, 2016; Kulu, 2003, 2004; White et al., 1995). This rural-urban difference exacerbates initially as urban areas experience rapid fertility decline, but as this fertility decline diffuses spatially from urban to rural areas with time, the difference reduces gradually (Lerch, 2019b, 2019a).

Focusing on migration, the literature shows that migrants tend to have a different fertility pattern than non-migrants. However, the extent to which the fertility behaviour of migrants differs from that of non-migrants remains contested. In the current literature, there are four dominating hypotheses on the fertility patterns of migrants. The socialization hypothesis suggests that migrants tend to maintain fertility behaviour similar to their childhood environment, and changes in fertility towards destination context is only expected after one generation (Hervitz, 1985). The adaptation hypothesis, on the other hand, states that migrants gradually adapt to the fertility preferences at their place of destination due to new economic, social and cultural contexts, and this adaptation process typically lasts less than ten years (Hervitz, 1985). The selectivity hypothesis believes that migrants tend to have different social-economic composition than the overall population at origin, and thus their fertility preferences is different (Hervitz, 1985). The disruption hypothesis suggests that fertility is particularly low immediately following migration events due to physiological stress, but this is temporary and the fertility is expected to resume over time (Hervitz, 1985).

These hypotheses are inconsistent and even contradictory with each other, but nevertheless they were validated in numerous country-specific studies. For example, the socialization effect has been validated in the US among rural-to-city migrants, as well as Italian and Mexican immigrants, showing fertility behaviour similar to their place of origin in the first generation, whereas their kids have closer fertility patterns as their destination population (Goldberg, 1959; Rosenwaike, 1973; Stephen & Bean, 1992). The adaptation effect has been observed among internal migrants in Estonia, Austria and Poland (Kulu, 2003, 2004), in South Korea, Mexico and Cameroon (Lee & Pol, 1993), in Cotonou, Benin (Banougnin et al., 2018), and among immigrants in the USA (Kahn, 1994). The selectivity effect among internal migrants is observed in Peru (White et al., 1995) and in Cotonou, Benin (Banougnin et al., 2018), and the authors argued that migrants into big cities tend to have lower fertility because of their fertility preference and socio-economic conditions. As for disruption effect, Stephen & Bean (1992) and Goldstein & Goldstein (1983) observed a lower fertility around migration event, but this effect was temporary. Moreover, several studies also observed an interdependency between migration and fertility decisions, in which individuals migrate for marriage, and hence having a higher fertility immediately after migration event (Courgeau, 1985; Mulder & Wagner, 1993). These

evidence highlights the high complexity of the fertility behaviour of migrants, and the necessity to further test these hypotheses to determine to what extents and in which conditions they apply.

Existing literature shows that migratory flow could be a key explainer of different fertility behaviour of migrants. Rural-to-urban migrants tend to have fertility halfway between non-migrants at their origin and destination (Goldstein & Goldstein, 1981; Lerch, 2019a; Menashe-Oren & Sánchez-Páez, 2023). Urban-to-rural migrants, on the other hand, have more mixed observations. Goldstein & Goldstein (1981) claimed that in Thailand, urban-to-rural migrants maintain the low fertility level similar to urban areas, whereas Lerch (2019a) argued that migrants tend to adopt the higher fertility of the non-migrants at their destination, using data from 60 developing countries. In the sub-Saharan context, rural-to-rural migrants tend to have similar fertility as rural non-migrants, and urban-to-urban migrants tend to have lower fertility than urban non-migrants (Menashe-Oren & Sánchez-Páez, 2023). Over the course of development, rural-to-urban migrants tends to transition from high fertility to low fertility, alongside the rising cost of living in urban areas (Liao et al., 2020). The shifting fertility behaviour of migrants can further alter the overall fertility level. Lee and Pol (1993) observed that rural-to-urban migration lowered the national fertility by 2.6 in South Korea, by 1.5 in Mexico, and by 0.13 in Cameroon. This shows the importance of understanding the fertility behaviour of migrants over different development stages for planning for future demographic trends, resource allocation, and policy intervention. However, the current literature only provides a fragmented picture of this, as Goldstein & Goldstein (1981) focused on Thailand, and Menashe-Oren & Sánchez-Páez (2023) on male fertility in sub-Sahara Africa, both of which only cover a short span of development stages. Lerch (2019a) and Liao et al. (2020) included more countries in their analysis, but they only included rural-to-urban and urban-to-rural migration, ignoring the fertility behaviour of those migration within rural and urban areas. Moreover, urban areas are not homogeneous in terms of development potential and attractiveness for migrants, and more disaggregated definition of urban areas is needed to better understand the dynamics of fertility behaviour of migrants. Moreover, none of the existing studies systematically tested the four dominating hypotheses mentioned above over a representable sample of countries at different development stages.

Data

In this study, we selected 39 census rounds of the Integrated Public Use Microdata Series (IPUMS) International with first-or second-level geographic information on the residence at the time of the census collection for each resident, the number of years they have been residing in that locality, as well as their previous residence (Minnesota Population Center, 2019). The selection includes eight countries in Africa, six countries in Asia and six countries in Latin America, ranging from 1971 to 2020. This restricted sample with detailed residential and migration information allows us to have a closer look at the fertility behaviour of migrants before and after migration events, which help us better understand the interaction between migration and fertility.

For each administrative unit of each country in the selection, we used Global Human Settlement Layer (GHSL) data to look at the population distribution (European Commission, 2023). If a unit has more than 50% of its population living in areas with a population density of 1,500 or more inhabitants per km^2, then the unit is classified as “city”; with a population density between 300 and 1,500 inhabitants per km^2, as “towns and suburban areas”; with a population density of 300 or less inhabitants per km^2, as “rural” (European Commission, 2023). For the administrative units that are classified as “city”, we further aggregated the units that touch each other, calculated their total population, and ranked all the aggregated cities within each country into three tiers using tertiles. This further classification of cities into tiers are referred to as Urban Hierarchy in the literature. The determination of urban hierarchy is often based on the relative economic development (Chen & Partridge, 2013), population size (Krugman, 1996), or connectivity (Borchert, 1967, 1972; Philbrick, 1957) among cities. Here, we rely on population size solely, which is the simplest, yet widely applied classification method for urban hierarchy (Mu et al., 2022; Plane et al., 2005). For administrative units outside cities, we merged the administrative units with the same classification and touch each other together to form a new administrative unit, to avoid having administrative units with too little inhabitants. These merged administrative units for cities and areas outside cities are hereafter referred to as merged geographical units. The aggregation stops if the population reaches the average population of cities of that country, or if no touching administrative units could be found. Overall, we have three tiers, namely tier 1 big cities, tier 2 smaller cities, and tier 3 towns, suburban and rural areas. Tier 1 big cities are cities with a population size in the top tertile of the national city

population distribution. This classification was performed for every 5 years between 1975 and 2020, creating a time varying definition of urban hierarchy. This dataset is maintained by the URBDEMO lab, at EPFL, Switzerland.

Method

1 Own Child Method

In this study, we analyse the age-specific fertility rate (ASFR) and total fertility rate (TFR) of migrants and non-migrants. ASFR measures the number of birth per woman for a specific age over the reproductive ages, and TFR measures the expected live births of a woman over reproductive ages, which can be calculated by summing ASFR (United Nations, 2025). In order to calculate ASFR and TFR, we employ Own Child Method (OCM) to estimate the number of children born to each woman between 15-49 years old, accounting for mortality of children and mothers (L. J. Cho et al., 1965; Luther & Cho, 1988). The OCM uses the age of children and mothers within the same household to estimate the number of births by age of mother in each year prior census enumeration (L.-J. Cho et al., 1986). OCM as a method for fertility estimation has some key advantages. First, it can be applied in cases where vital registration on birth is missing, especially common in less developed countries (Avery et al., 2013; L.-J. Cho et al., 1986). Second, it enables tabulation of fertility by other variables recorded in census data (L.-J. Cho et al., 1986). Third, it can reconstruct fifteen years of birth history before census collection time (L.-J. Cho et al., 1986). On the other hand, OCM is limited by age misreporting, which can severely affect its estimation quality (L.-J. Cho et al., 1986). Moreover, it excludes deceased children and mothers, and surviving children no longer living in the same household at the time of census enumeration (Goldstein & Goldstein, 1981; Luther & Cho, 1988). The problems related to the mortality of children and mothers can be mitigated by using appropriate life tables for the population, following formulation specified by Cho et al (1986). The unlinked surviving children can be redistributed across mothers at the aggregate level based on their place of residence.

Using the OCM, we reconstructed each mother's birth history for the 15 years preceding the census, following Toulemon's method (2004). For each retrospective year t (1-15 years before census), we back-calculated the mother's age, the child's age, and the number of year that they had been living in that locality by subtracting t from their recorded values. Any child whose back-calculated age was zero in year t was recorded as a birth in that year. For each five years over the 15 years, we aggregated the data based on the current and previous place of residence, as well as the number of years residing in the current place of residence. From each microcensus data, we can extract fertility data for three time points, corresponding to the year of census enumeration, five years before that, and ten years before that. For the non-linked children, we calculated the total number of them for each combination of current and previous place of residence, and the number of years residing in the current place of residence. We then redistributed them proportionally across mothers of different age with the same residential trajectory based on the age structure of mothers. After this step, we further proportionally redistributed the mothers and their corresponding births with missing migration information. After redistribution, we used national-level life table provided by Population Division, Department of Economic and Social Affairs of the United Nations to correct for the mortality of women and children (2025). Although the national-level data ignores the heterogeneity in mortality across different regions within the same country, this is the only dataset on mortality that is widely available across all countries in our sample. This data is further aggregated at merged geographic unit level for further analysis. For non-migrants, this returns a table of the total number of women at each age and their corresponding births in each merged geographical unit over the five-year period. Note that in this study, we considered those who migrated with less than 10 years old as non-migrants at the current place of residence. For migrants, we have the total number of women at each age and their corresponding births who migrated from one to another merged geographical unit and who have been residing in their current locality for a certain number of years. From this, we can further determine the age of migration by subtracting the age of women with the number of years residing in the current locality. This detailed fertility table can then be used to determine ASFR and TFR.

2 Modelling

In order to test the hypotheses, we developed three sets of statistical models. In all models, a key independent variable is the national TFR, which we calculated directly from the dataset using the OCM described above. The first set of models estimated the ASFR among non-migrants within each level of urban hierarchy. For this, we employed generalised additive mixed model (GAMM) to estimate ASFR across fertile ages and national TFR. In order to capture the potentially complex and non-linear interaction between age and the national TFR, we included a 2D tensor product smooth term. This approach is particularly well-suited for modelling interactions between variables measured on different scales or with differing levels of smoothness. We used thin plate regression spline with a basis dimension of eight to allow flexible estimation of smooth effects in each direction without overfitting. A random effect for country was included to account for unobserved heterogeneity in terms of ASFR patterns across national contexts. We specified a Gamma distribution with a log link to ensure that the prediction ASFR values are positive. We performed this modelling for each level of urban hierarchy, so that we account for the potentially different ASFR over age patterns across urban hierarchy. The second set of models is similar to the first set but considering migrants and their migratory flow across the urban hierarchy. Note that migratory flow from tier 1 to tier 1 big cities is not being considered here, as most countries only have tier 1 big city. We ran the model for each migratory flow to account for the possible heterogeneity across fertility behaviour of different migrants. In the third set of models, we estimated the ASFR among migrants, disaggregated by migratory flows across the urban hierarchy. To capture the fertility behaviour around the migration event, we used the IPUMS variable indicating years of residence in the current place. This gave indication on the number of years since migration events. Due to limitation of data, we had retrospective information covering up to 15 years prior to the migration event. We used two separate three-dimensional tensor product smooths, with the additional dimension being the number of years since migration events. We also used thin plate regression spline with a basis dimension of eight here. The first smooth estimated it for pre-migration period, and the second for post-migration period, with the year of migration classified as part of the "post" period. For each migratory flow, we fitted a GAMM to estimate ASFR as a function of age, national TFR, and number of years since migration, while accounting for unobserved heterogeneity across countries using random intercept. The binary migration phase was included as a linear term. Similar to above, we used Gamma distribution with a log link to ensure positive ASFR predictions.

Results

In the result section, we compared the fertility patterns of migrants with that of non-migrants. For each model above, we predicted the ASFR for each age between 15 and 49, national TFR between 2 and 6, and number of years since migration between -15 and 49, with negative values corresponding to years before the migration event. The predictions also include 95% confidence interval. We then compared the fertility between migrants and non-migrants at their origin and destination and calculated the percentage difference between the two. If the value of migrants lies within the confidence interval of the non-migrants, then the percentage difference between the two is considered as not statistically significant. In order to facilitate the comparison, we aggregate the age at migration into four groups: 1) those who migrated at 19 years old or less, 2) those who migrated between 20 and 24 years old, 3) those who migrated between 25 and 34 years old, 4) those migrated at 35 years old or more. We also aggregated the number of years since migration into nine groups: 1) 10 or more years before migration, 2) 6 to 9 years before migration, 3) 3 to 5 years before migration, 4) 1 to 2 years before migration, 5) year of migration, 6) 1 to 2 years after migration, 7) 3 to 5 years after migration, 8) 6 to 9 years after migration, 9) 10 or more years after migration. We averaged the values over different national TFR level, as the calculated percentage difference does not differ greatly across different national TFR. In the aggregation, if more than half of the values of the percentage differences for a specific aggregation are within the confidence interval, then the aggregated value is considered as not statistically significant. Following this aggregation, we introduce the results by the direction of migration flows.

1 Migrating Up the Urban Hierarchy

Figure 1: Around Here

Here, we introduce results for the migrants who moved up the urban hierarchy, namely from towns, suburban and rural areas to small cities or big cities, and from smaller cities to big cities. These migrants typically move from a higher to

a lower fertility context. The results are shown in figure 1. First, we focus on the migrants that moved before the age of 24 (hereafter referred to as “younger migrants”). Before the migration event, their fertility is lower than the non-migrants at their origin and destination with statistical significance. Their fertility is slightly closer to their destination than their origin, suggesting a slight selection effect among migrants towards lower fertility at their destination. At the year of migration, the difference between migrants and non-migrants tends to further reduce instead of widening. This suggests that migration event itself does not necessarily disrupt the fertility patterns. One to two years after the migration event, the fertility of migrants becomes significantly higher than their destination population and slightly higher or similar to their origin population. In the subsequent years after migration, the differences in fertility compared to destination population reduce to near zero without statistical significance, whereas the differences to origin population become negative with statistical significance. Here, we observe an adaptation effect, as the fertility behaviour of migrants gradually becomes closer to the destination population after 6 to 9 years from the migration event. We can also observe a catch-up effect, as fertility increases right after migration event to compensate for the lower fertility level before migration, which can be due to migration for family reunification or for family formation.

Second, we look at the migrants who moved after reaching 25 years old (hereafter referred to as “older migrants”). Their fertility remains lower than or close to the non-migrants at their origin and destination before and after migration event. Out-migrants from towns, suburban and rural areas tend to have statistically insignificant difference with their destination population, especially around and after the migration event, suggesting a selection towards the lower fertility behaviour at their destination. Migrants from smaller cities to big cities also tend to have lower or similar fertility than their origin and destination population, but the difference tends to be more exacerbated. This indicates a selection effect towards a lower fertility pattern than both origin and destination.

Figure 2: Around Here

Looking at TFR, figure 2 shows that the overall fertility of out-migrants with upward mobility is significantly lower than the non-migrants at their origin. This suggests that migrants moving up the urban hierarchy do not exhibit socialisation effect. The overall fertility patterns of out-migrants from towns, suburban and rural areas closely follow that of non-migrants at their destination without statistical significance. The migrants from smaller to big cities have different characteristics between younger and older migrants. Younger migrants have similar overall fertility as their destination, whereas older migrants have much lower fertility than their destination. This validates the adaptation effect of younger migrants, and selection effect of older migrants mentioned before.

2 Migrating Down the Urban Hierarchy

Figure 3: Around Here

Secondly, we look at the migrants moving down the urban hierarchy, namely from big cities to smaller cities and towns, suburban and rural areas, and from smaller cities to towns, suburban and rural areas. These migrants typically move from a lower to a higher fertility context. The visualization of the results is shown in figure 3. Before the migration event, the migrants moving down the urban hierarchy tend to have higher to similar fertility patterns to non-migrants at their origin, and statistically significantly lower fertility than their destination population. This pattern suggests that migrants moving down the urban hierarchy are slightly selected towards higher fertility behaviour than their origin population before migration.

After migration events, we observe different patterns between younger and older migrants. Among the younger migrants, the fertility increases one to two years after migration, reaching a level that is significantly higher than their origin population. Their fertility is also higher than their destination population with statistical significance, but to a lesser magnitude. Over the subsequent years after migration, the difference in fertility between migrants and non-migrants reduces gradually, reaching a level that is similar or slightly higher than the non-migrants at origin, and lower than the non-migrants at destination. This shows that younger migrants tend to reach a fertility level that is between the non-migrants at their origin and destination, with limited adaptation effect. Older migrants tend to have similar or slightly higher fertility as their origin population, and similar or lower fertility than their destination population before and after migration event. This suggests a socialisation effect among this group of migrants.

Looking at TFR of migrants, figure 2 shows that the overall fertility patterns of younger migrants tend to be higher than their origin and lower than their destination, and the difference with their destination tends to be smaller. This validates the restricted adaptation we observed before. The older migrants tend to have lower fertility than both their origin and destination, and the difference is smaller to their origin. It is worth noting that the fertility patterns of younger migrants from smaller to big cities are not statistically significant from the non-migrants at their origin and destination, showing both socialisation and adaptation effect. The older migrants from big and smaller cities to towns, suburban and rural areas have statistically insignificant difference in fertility when compared to their origin, showing a socialisation effect.

3 Migrating Within the Same Urban Hierarchy

Figure 4: Around Here

Thirdly, migrants moving within the same urban hierarchy tend to have lower fertility before the year of migration with statistical significance. After the migration event, the younger migrants tend to have higher fertility than non-migrants immediately after the migration event, and over time they reach fertility level similar to or lower than the non-migrants. The difference is mostly statistically significant among migrants within towns, suburban and rural areas, and statistically insignificant among migrants within smaller cities. On the other hand, the fertility pattern of older migrants is similar to non-migrants without statistical significance in the differences.

Looking at TFR, as shown in figure 2, we can observe that the TFR of migrants moving within the same tier is similar or lower than the non-migrants. The younger migrants have similar fertility as the non-migrants without statistical significance. The fertility of older migrants tends to be lower than the non-migrants with statistical significance in the difference. This result suggests that the lower fertility of younger migrants before migration observed in figure 4 is compensated after migration events, showing a catch-up effect and socialisation/adaptation effect. The older migrants, on the other hand, also have a catch-up effect, but they are also selective as their overall fertility differs from the non-migrants.

Discussions

The results show that the fertility behaviour of migrants depends on their age of migration, migration flow, and time since migration. Subsequently, the socialisation, adaptation, selection and disruption hypothesis are not universally applicable. First, we look at upward migrants, who tend to have lower fertility than their origin. The younger migrants tend to be slightly selective towards lower fertility before migration, and they tend to adopt to the lower fertility patterns of their destination population gradually over a course of 6 to 9 years after migration, showing a mixture of selection and adaptation effect. Their overall fertility is similar to their destination and significantly lower than their origin population due to their early adaptation of fertility behaviour. The older migrants are more selective. Those from towns, suburban and rural areas have fertility patterns closely aligning their destination population across different phases of their fertile ages, and the migrants from smaller cities to big cities tend to have similar or lower fertility than their destination counterparts. As a result, the overall fertility of the former is similar to their destination, and the latter significantly lower than their origin and destination, showing a strong selection effect.

Second, we focus on downward migrants, who tend to have lower fertility than their destination population. The younger migrants towards towns, suburban and rural areas tend to be slightly more selective towards higher fertility before migration. Over the years after migration, they partially adopt to their higher fertility of destination, reaching a total fertility much higher than their origin and slightly lower than their destination. This indicates a mix of selection and adaption effect. The fertility of those moving from big cities to smaller cities is somewhere between their origin and destination, but not significantly different from neither of them. Among the older migrants, we observe a more dominant socialisation effect, as their total fertility tends to be close to their origin population and much lower than their destination. The only exception here is those who migrated from big to smaller cities at age of 35 or higher. They have lower fertility than both their origin and destination, suggesting a selection effect towards lower fertility.

Third, we look at migrants moving within the same urban hierarchy. The younger migrants tend to have similar total fertility as the non-migrants, showing a socialisation/adaptation effect. The older migrants tend to have lower fertility than the non-migrants, showing their selective nature in fertility behaviour. This division between younger and older migrants aligns with the observation for migrants with upward mobility.

Lastly, we do not observe disruption effect in our results, but rather a catch-up effect. The fertility behaviour of migrants is characterised by a relatively stable or increasing fertility before migration event, a spike right after migration event, which reduces gradually over years. This spike is more evident as the age of migration decreases. The fertility does not reduce around the fertility event, suggesting that the migration event itself does not necessarily disrupt fertility. This immediate spike after migration event is likely due to migration for family reunification or family formation (Courgeau, 1985; Mulder & Wagner, 1993), especially among the younger migrants. This spike is not as evident among older migrants, as it is likely that they have fulfilled their fertility desire before the migration event, or they migrate more for other motivations.

In summary, we observe that younger migrants tend be slightly selective prior migration and adopt their destination fertility post migration. This adaption is greater among migrants with upward or same level mobility and is less strong among migrants with downward mobility. The older migrants tend to maintain their lower fertility behaviour when they move downward, and more selective towards lower fertility when they move upward or within the same tier. This difference between younger and older migrants could be due to several factors. Younger migrants could be more easily influenced by the local fertility behaviour as they are typically at the early ages of childbearing ages, leaving them sufficient time to adjust and adopt. The older migrants, however, typically pass their early stage of childbearing ages, and are more likely have partially or fully fulfilled their childbearing desires before migration. The educational composition of migrants could also play a key role in this difference. However, we were unable to explore this path due to limited data and framing. This gap can be further explored by researchers to further enhance our understanding on fertility behaviour of migrants. Moreover, this study is limited by the data availability, as not all countries provide this detailed fertility data. Future researchers should explore other possible source of data to further enrich the observation and analysis.

This is the first article that analysed the fertility behaviour of migrants on a macro-level, disaggregating the specific fertility by age of migration and different time of their life, using the year of migration as a reference. This allows us to look at the age specific fertility rate of migrants at each year before and after the migration event, capturing detailed shift in fertility and the impact of migration on this shift. The results show that the dominant hypotheses for fertility behaviour of migrants, namely socialisation, adaptation and selection hypothesis, are each valid under certain circumstances, depending on the age of migration and the direction of migratory flow. As a result, the fertility behaviour of migrants should be analysed and interpreted based on conditions, rather than using a one-fit-all theory. Therefore, this article provides a new and holistic perspective to this long-debated field, and its detailed fertility data allow us to analyse fertility with unprecedented scale and detail. The result of this study could help regional governments and policymakers better understand the impact of migration on population dynamics, therefore plan for infrastructure and design for policies that can better cater the needs of the internal migrants.

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Appendix

Appendix 1: List of Countries, Census Rounds, and Tier 1 City Information

Country Name	ISO2 Code	Census Years	2020 Tier 1 City	2020 Population

Africa				
Benin	BJ	1992, 2002, 2013	Cotonou	2,701,114
Cameroon	CM	1976, 1987, 2005	Yaoundé	5,251,586
			Douala	3,753,966
Egypt	EG	1996, 2006	Cairo	36,740,171
Morocco	MA	1982, 1994, 2004	Casablanca	4,706,470
Mali	ML	1998, 2009	Bamako	5,072,788
Malawi	MW	2008	Blantyre	1,339,733
Togo	TG	2010	Lomé	2,293,340
Uganda	UG	1991, 2002, 2014	Kampala	5,786,234
Asia				
Kyrgyzstan	KG	1999	Bishkek	1,911,578
Cambodia	KH	1998, 2008, 2019	Phnom Penh	3,667,413
Myanmar	MM	2014	Yangon	9,291,750
Mongolia	MN	2000, 2010, 2020	Ulaanbaatar	1,706,502
Malaysia	MY	1980	Kuala Lumpur	9,520,500
The Philippines	PH	1990	Manila	34,814,846
Latin America				
Cuba	CU	2002, 2012	Havana	2,414,523
Guatemala	GT	1981, 1994	Guatemala City	3,922,313
Haiti	HT	1971	Port-au-Prince	2,658,968
Brazil	BR	1980, 1991, 2010	São Paulo	23,652,343
Ecuador	EC	1982	Quito	5,081,179
Uruguay	UY	2011	Montevideo	1,323,828

Table X: A list of all countries and census rounds included in this study, as well as the Tier 1 cities and its population as of 2020

Appendix 2: Additional Plots

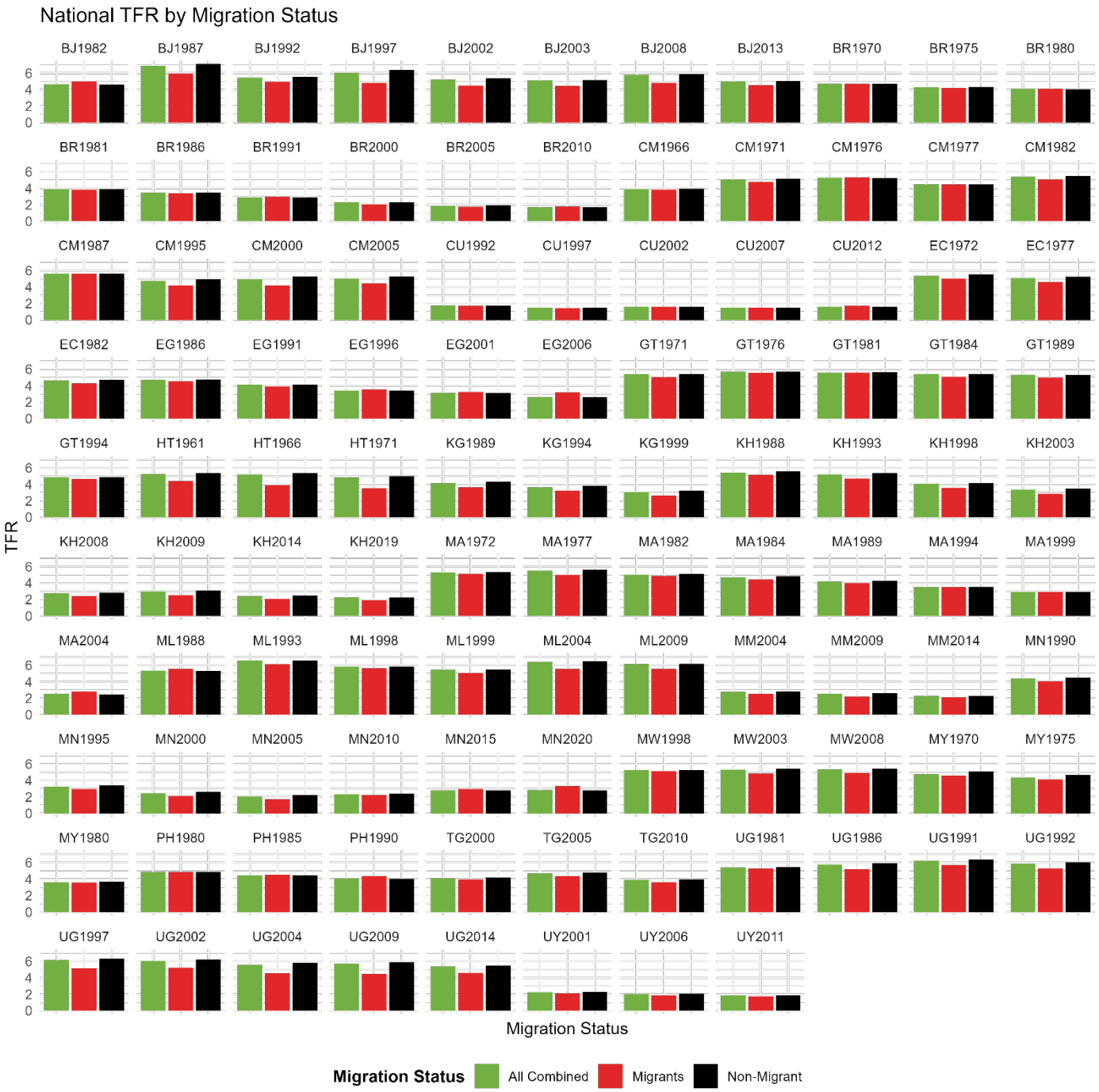

Figure X: National TFR for all population, for migrants and for non-migrants, for each year in our selection of data. Each census rounds have three subplots, corresponding to the year of census collection, 5 years before, and 10 years before (Minnesota Population Center, 2019)

Figure X: National Level TFR, and TFR for each tier of urban hierarchy, for each year in our selection of data (Minnesota Population Center, 2019)

Figures

Figure 1: shows the percentage difference in ASFR among migrants and non-migrants at their origin and destination, for those moving **up** the urban hierarchy. The figure is averaged over national TFR, as well as groups of age at migration.

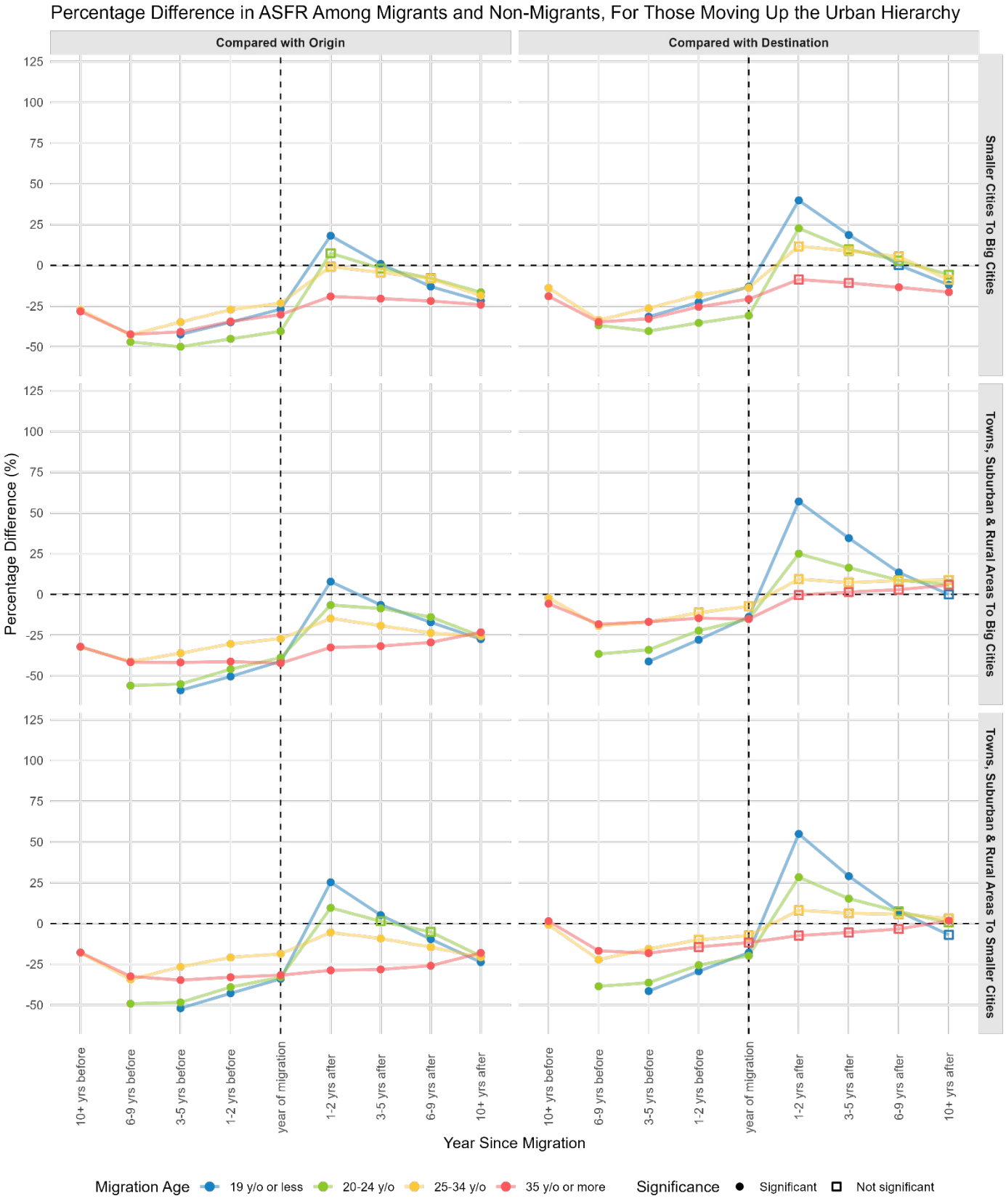

Figure 2: percentage difference in TFR, among migrants and non-migrants at their origin and destination urban hierarchy tier. It shows statistical significance. It shows TFR by migration age.

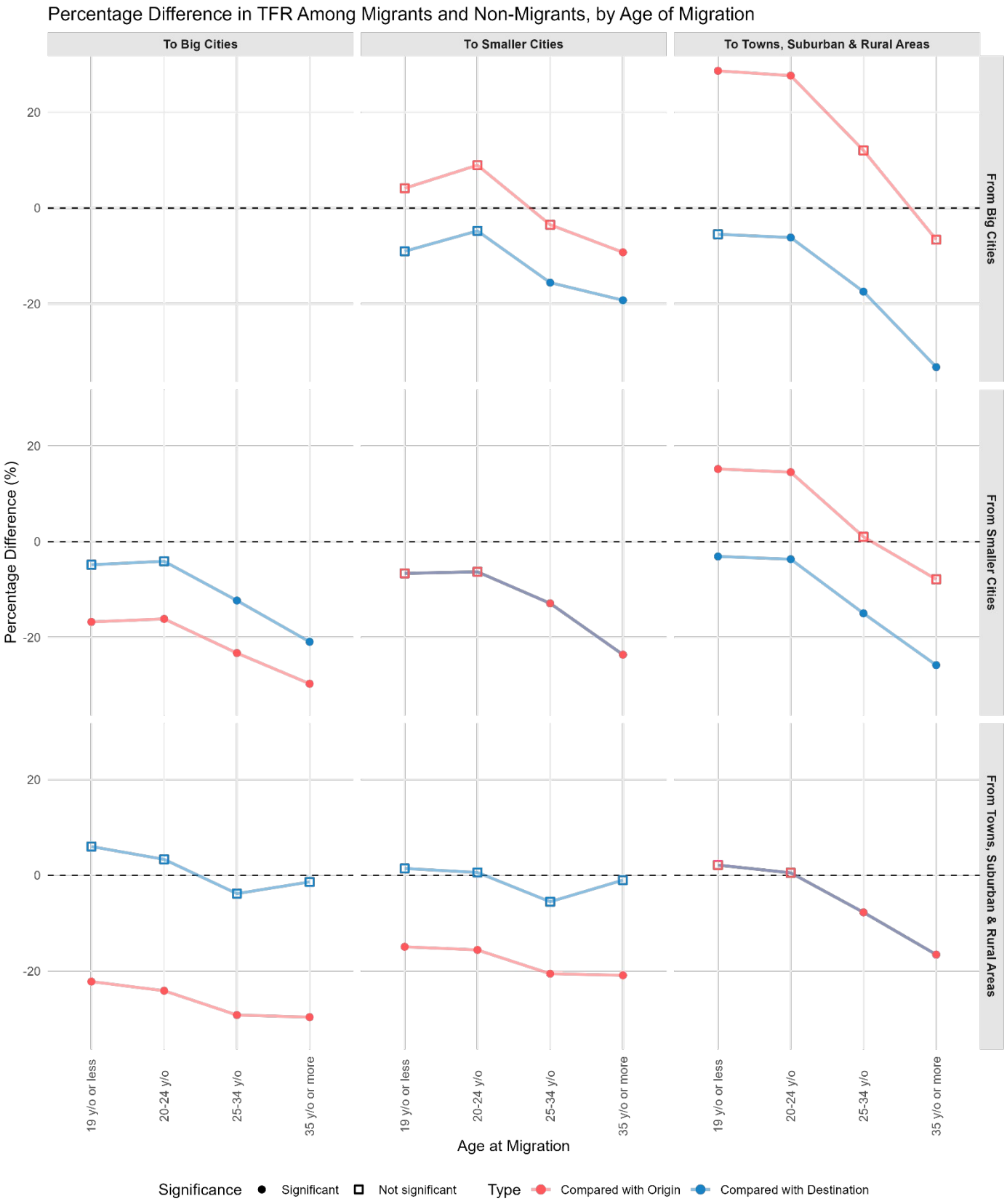

Figure 3: shows the percentage difference in ASFR among migrants and non-migrants at their origin and destination, for those moving **down** the urban hierarchy. The figure is averaged over national TFR, as well as groups of age at migration.

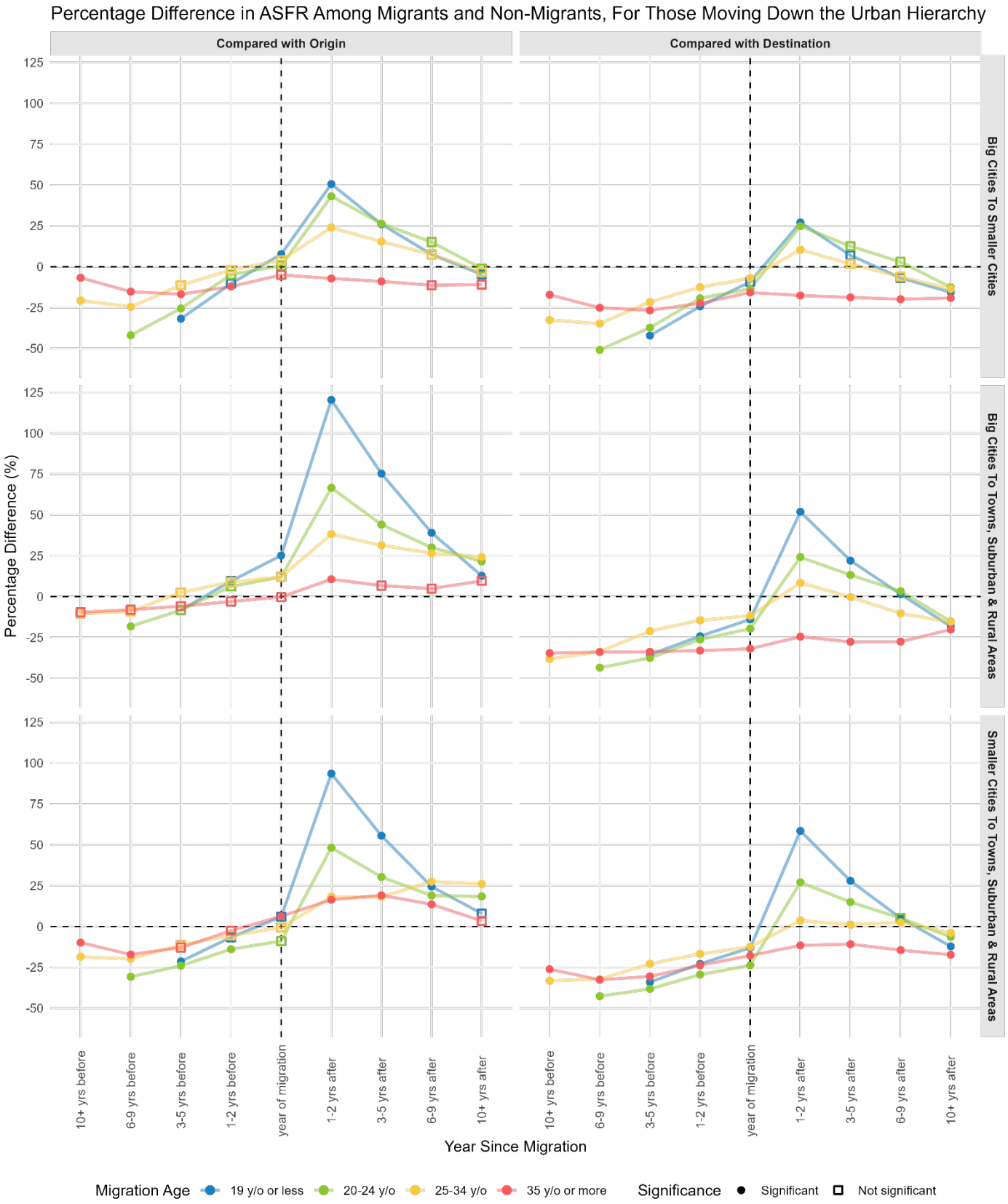

Figure 4: shows the percentage difference in ASFR among migrants and non-migrants at their origin and destination, for those moving **in the same** urban hierarchy. The figure is averaged over national TFR, as well as groups of age at migration.