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Abstract

Ray and Genicott (2023) proposed a new metric for upward mobility, which also captures the concept of inclusive growth. We proposed several decomposition analyses of this metric using household-level data, which can help identify the factors that contributed to the observed inclusive growth. We applied these methods to Vietnam, a country that experienced rapid and equitable economic growth. Our findings reveal that rural residents, who were initially left behind, experienced more inclusive growth than urban residents, contributing to overall national-level inclusive growth. The impact of household demographic factors such as education levels and job status was relatively minor in explaining inclusive growth in Vietnam. Instead, regional economic performance emerged as a key driver of inclusive growth. The limited impact of education improvement is likely because the poor tended to be low-educated elderly people who would not directly benefit from the improvement of education. These findings underscore the importance of economic growth and expansion of social security systems, such as old-age pension programs, to achieve inclusive growth.

JEL Classification:

Keywords: Intergenerational income mobility

1 Introduction

Is economic growth good for the poor? While the cross-country study shows positive results (Dollar et al., 2016), it's driving force is still unclear. The extent to which the poor can benefit from economic growth depends on whether economic opportunities are accessible to the poor, which in turn depends on the economic structure of the country and the characteristics of the poor population. Recent studies on intergenerational mobility have shown lower upward mobility among black Americans and American Indians (Chetty et al., 2020), suggesting that economic opportunities are not equally open to all, even in developed countries. How to promote economic growth benefiting the poor is the central topic of inclusive growth (Ianchovichina and Lundström, 2009).

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While there are many studies measuring the pro-poorness of economic growth, few have empirically investigated what factors contributed to economic growth benefiting the poor. Literature on pro-poor growth typically assessed the pro-poorness of economic growth by examining the relationship between growth rates and changes in poverty indices (Datt and Ravallion, 1992; Kakwani and Pernia, 2000; Dollar et al., 2016; Lakner et al., 2022; Balasubramanian et al., 2023).[1] However, these measures rely on poverty lines, leading to a discontinuous treatment of income growth for households just below and just above the poverty line, and ignoring the welfare improvement of those just above the poverty lines. This undermines the validity of these measures for assessing how economic growth benefited poor people. This issue can be addressed by using the growth incidence curve (Ravallion and Chen, 2003) or poverty growth curve (Son, 2004), which investigates the mean growth rate for p-th quantile or bottom p percent of income distribution. However, these measures are intended to evaluate the pro-poorness of growth experiences, and are not suited to examine the factors contributing to pro-poor growth or inclusive growth. Literature on inclusive growth have argued how to achieve inclusive growth (Ianchovichina and Lundström, 2009), but these are descriptive and lack rigorous empirical investigations, partly due to the lack of consensus on the definition and measurement of inclusive growth.

In this paper, we apply a novel metric proposed by Ray and Genicot (2023) to measure inclusive growth and conduct decomposition analyses using Vietnamese household survey data to examine the factors contributing to inclusive growth. Ray and Genicot (2023) derived an upward mobility measure based on a set of axioms (referred to RG index hereafter), which is also well-suited for measuring inclusive growth. RG index aggregates the income growth of all individuals, with increasing weights given to the income growth of poorer individuals. Unlike existing pro-poor growth measures, RG index does not depend on poverty lines and values income growth of individuals above the poverty lines though the weights are minishing in the level of income. These characteristics well captures the requirement of inclusive growth – "pace and pattern of growth" (Ianchovichina and Lundström, 2009): RG index both favors higher growth and growth benefiting poorer individuals. Exploiting the relatively simple functional form of RG index, we propose procedures to decompose RG index into two subgroups, and into the composition effect and structure effect using the reweighting method (DiNardo et al., 1996) and the RIF regression approach (Firpo et al., 2009). The subgroup analysis requires no additional assumptions but only consider two subgroups, while the reweighting method and RIF approach can accounts for a variety of covariates with some additional assumptions. Another advantage of RG index is its "panel-free" feature: it does not require panel data and only depends on

[1] While there is a lack of agreement on the definition and measurement methods for pro-poor growth (Lopez, 2004; Son, 2007), most studies decompose changes in the poverty index into growth effects and inequality effects, assessing the pro-poorness of growth by the ratio of the change in the poverty index to the growth effects (McCulloch and Baulch, 1999; Kakwani and Pernia, 2000; Kakwani and Son, 2008; Mishra, 2015).

changes in the overall income distribution between two distinct periods. This panel-free feature expands the applicability of our decomposition procedures to many countries without nationally representative long panel data.[2]

We conduct decomposition analyses using representative repeated cross-section household data from Vietnam, spanning from 2002 to 2020, when equitable economic growth was observed (Benjamin et al., 2017). Subgroup analyses reveal that rural residents, who were initially left behind, experienced more inclusive growth than urban residents, contributing to overall national-level inclusive growth.

Aggregate decomposition and detailed decomposition revealed that the composition effects of household demographic variables played little role in explaining pro-poor growth in Vietnam. Instead, regional-level economic performance emerged as an important factor in inclusive growth. The limited impact of education improvement is likely because the poor tended to be low-educated elderly people who would not directly benefit from the improvement of education. These findings underscore the importance of economic growth and expansion of social security system, such as old-age pension programs, to achieve inclusive growth.

This study substantially expands our knowledge of inclusive growth. Existing studies on pro-poor growth exclusively focus on decomposing growth rates into pure growth effects and distributional effects (Kakwani and Pernia, 2000; Son, 2007), and only a few focus on the determinants of pro-poor growth (Kraay, 2006). Kraay (2006) conducted cross-country analyses to find that poverty reduction was largely driven by a high growth rate of average incomes. However, these studies has not intended to identify contributing factors to pro-poor growth or inclusive growth. Conversely, the literature on inclusive growth has derived several policy suggestions to achieve inclusive growth (Ianchovichina and Lundström, 2009), but these analyses are often descriptive and lack rigorous empirical investigations, partly due to the lack of consensus on the definition and measurement of inclusive growth.

In this study, we use household-level data to show that the major contributing factor to inclusive growth is economic growth, and that educational attainment or other household-level characteristics play a limited role in explaining pro-poor growth. This finding also corroborates with the findings from growth acconuting and development accounting, which emphasizes the importance of the growth of total factor productivity (TFP) and relatively smaller role of human capital accumulation (Jones, 2016).

The next section explains RG index followed by the decomposition methods. Section 3 provide a brief explanation of the data set used. Section 4 report the results. Section 5 concludes.

[2] The literature on inclusive growth typically emphasizes the importance of "*ex-ante* analysis of sources of, and constraints to sustained, high growth" (Ianchovichina and Lundström, 2009; **?**), and considers the measurement of pro-poor growth as *ex-post* analysis that track various outcome measurements for evaluation. However, accumulating rigorous *ex-post* evaluation of growth experiences is essential for improving the credibility of *ex-ante* analysis, and hence our studies also contributes to the discussion of inclusive growth literature.

2 Methods

2.1 RG index and its interpretation

Ray and Genicot (2023) derived RG index from a set of axioms. We briefly explain these axioms and argue that RG index is an appropriate scalar measure of inclusive growth in terms of both the implications of these axioms and the resultant functional form of RG index.

They began by introducing six axioms to derive an instantaneous upward mobility $M(\mathbf{y}, \mathbf{g})$, which is defined over the baseline income $\mathbf{y} = (y_1, y_2, \ldots, y_n)$ and instantaneous growth rate of income $\mathbf{g} = (g_1, g_2, \ldots, g_n)$ of the finite population of size n. These axioms are: (a) Zero Growth Anchoring, (b) Income Neutrality, (c) Growth Progressivity, (d) Growth Alignment, (e) Local Merge, and (f) Binary Growth Tradeoffs. Then they impose additional two conditions, namely reducibility and additivity, to derive a discrete-time version of the upward mobility that can be applied to the actual datasets.

The first two axioms, Zero Growth Anchoring and Income Neutrality, are intuitive and easy to interpret. The former requires that if no individuals experienced changes in income, the upward mobility should be zero, i.e., if $\mathbf{g} = 0$, then $M(\mathbf{y}, \mathbf{g}) = 0$ for any $\mathbf{y}$. Income Neutrality requires that for any scalar λ, $M(\mathbf{y}, \mathbf{g}) = M(\lambda\mathbf{y}, \mathbf{g})$, ensuring invariance to changes in the unit.

The next two axioms, Growth Progressivity and Growth Alignment, embody the concept of inclusive growth. Growth Progressivity requires that transfers of growth rates from relatively rich to poor individuals increase the measure, capturing the essence of inclusiveness of growth. Formally, if $\mathbf{g}'$ is a vector differing from $\mathbf{g}$ only in its ith and jth elements by $\epsilon > 0$ and $-\epsilon$, i.e., $\mathbf{g}' = (g_1, g_{i-1}, \ldots, g_i - \epsilon, g_{i+1}, \ldots, g_{j-1}, g_j + \epsilon, g_{j-1}, \ldots, g_n)$, then Growth Progressivity requires that if $y_i > y_j$, then $M(\mathbf{y}, \mathbf{g}') > M(\mathbf{y}, \mathbf{g})$. Growth Alignment axiom simply requires that if growth rates increase for all individuals, the measure should also increase, i.e., if $\mathbf{g}' > \mathbf{g}$, then $M(\mathbf{y}, \mathbf{g}') > M(\mathbf{y}, \mathbf{g})$. The remaining two axioms, Local Merge and Binary Growth Tradeoffs, impose cardinal and functional form restrictions.[3]

Ray and Genicot (2023) showed that an instantaneous upward mobility measure that satisfies these six

[3]To explain Local Merge, consider four societies, A, B, C, and D, and denote the upward mobility of each society by M_i, $i = A, B, C, D$. Society B is identical to society A. Society C is identical to society A but one individual whose growth rate is greater by ϵ, and society D is identical to society A but one individual whose growth rate is lower by ϵ. Now consider societies A and B merge to form society AB, and societies C and D merge to form society CD, and hence these new societies have the same average growth rate. Local Merge requires if $M_C - M_A \neq M_B - M_D$, then $M_{AB} \neq M_{CD}$. Binary Growth Tradeoffs axiom encapsulates the principle of "independence of irrelevant alternatives". In the above example, the only difference between the merged society AB and the merged society CD is two individuals. This axiom requires that the difference in upward mobility between these two societies should not depend on the characteristics of the other individuals than these two.

axioms can be represented with a quite simple form

$$M_\alpha(\mathbf{y}, \mathbf{g}) \equiv \frac{\sum_{i=1}^n y_i^{-\alpha} g_i}{\sum_{i=1}^n y_i^{-\alpha}} \tag{1}$$

for some $\alpha > 0$. Parameter α governs the weight for the income growth of the poor, or the degree of the inclusiveness of the growth, with a greater value of α placing more weight on the earnings of the poor. For example, $\alpha = 0.5$ places weight on individuals earning \$400 as twice as individuals earning \$1,600. If $\alpha = 1$, the relative weight between the two individuals is four. If α gets close to 0, then $M_\alpha^\Delta(\mathbf{y}(s), \mathbf{y}(t))$ converges to $\frac{\sum_{i=1}^n \ln y_i(t) - \sum_{i=1}^n \ln y_i(s)}{n(t-s)}$ or the unweighted average growth rate of individual earnings. Hence by varying the values of α, we can see if the benefit of the growth reached the very bottom of the poor.[4]

Because the actual data are typically recorded at discrete time intervals, the instantaneous upward mobility measure (1) is not applicable to existing data. To derive a discrete time version of upward mobility that can be applied to the actual dataset, Ray and Genicot (2023) impose two additional natural conditions: reducibility and additivity. Reducibility requires upward mobility over a given time interval to be fully determined by the collection of instantaneous upward mobility during the interval. Additivity requires that the upward mobility measure over a given time interval be the additive aggregation of the upward mobility measures of the subinterval. With these two conditions, they derive an empirical measure of the upward mobility applicable to the discrete time data as

$$M_\alpha^\Delta(\mathbf{y}(s), \mathbf{y}(t)) \equiv \frac{1}{t-s} \ln \left[\frac{\sum_{i=1}^n y_i^{-\alpha}(t)}{\sum_{i=1}^n y_i^{-\alpha}(s)} \right]^{-\frac{1}{\alpha}}, \tag{2}$$

where $\mathbf{y}(\tau)$ are the vector of income at time $\tau = s, t$. They also propose the relative upward mobility which net outs the aggregate growth effect,

$$K_\alpha^\Delta(\mathbf{y}(s), \mathbf{y}(t)) \equiv \frac{1}{t-s} \ln \left[\frac{\sum_{i=1}^n \left(\frac{y_i(t)}{\bar{y}(t)} \right)^{-\alpha}}{\sum_{i=1}^n \left(\frac{y_i(s)}{\bar{y}(s)} \right)^{-\alpha}} \right]^{-\frac{1}{\alpha}}.$$

that focuses on inequality.

One important feature of this measure is that panel data are not required because we only need the level of income (or expenditure) in each time period and do not need the growth rate of each individual's income. This feature is very important in the decomposition analysis because household-level data are required for decomposition analyses, but long panel data are rarely available and, if any, will not be representative of the

[4] A reduction in upward mobility with a higher α indicates that the poorest individuals are being left behind.

whole country. Furthermore, the measure depends only on the difference in the mean of $y_i^{-\alpha}$ between the two periods, which facilitates the decomposition analyses explained later.

We compute the discrete version of RG index (2) using household survey data. Since they are repeated cross-section data and the sample sizes differ across surveys, we measure the sample analogue of RG index

$$\hat{M}_\alpha^\Delta(\mathbf{y}(s), \mathbf{y}(t)) \equiv \frac{1}{t-s} \ln \left[\frac{\frac{1}{n_t} \sum_{i=1}^{n_t} y_i^{-\alpha}(t)}{\frac{1}{n_s} \sum_{i=1}^{n_s} y_i^{-\alpha}(s)} \right]^{-\frac{1}{\alpha}},$$

where $n(\tau)$ is the sample size at time $\tau = s, t$. In the empirical analyses below, we report RG index with $\alpha = \{0, 0.1, 0.3, 0.5, 1, 2\}$, where $\alpha = 0$ computes the average growth of per capita expenditure or income, that is, $\frac{\sum_{i=1}^n \ln y_i(t) - \sum_{i=1}^n \ln y_i(s)}{n(t-s)}$.

Note that RG index does not satisfy the focus axiom (Sen, 1976) widely adopted in poverty measures, which requires that the measure be invariant to income changes for the non-poor. However, with a large value of α, the income changes for the non-poor have a negligible impact on RG index. Further, the measure will not depend on arbitrary choices of the level of the poverty line, and will not suffer from the discontinuous treatment between those just above the poverty line and those just below the poverty line. Hence, the violation of the focus axiom is not problematic when measuring inclusive growth.

It is worth noting the difference between RG index and other existing pro-poor growth measures. Son (2007) categorized the pro-poor growth measure based on their concept, absolute or relative. While the absolute measures consider that growth is pro-poor only when the average income of the poor increases, resulting in a decline in poverty measures, relative measures require the income of the poor to grow faster than that of the non-poor, and hence focus more on inequality. Examples of absolute measures include the Growth Incidence Curve (GIC) (Ravallion and Chen, 2003) and the Poverty Growth Curve (PGC) (Son, 2004), while relative measures include the Poverty Bias of Growth (PBG) (McCulloch and Baulch, 1999), Pro-Poor Growth Index (PPGI) (Kakwani and Pernia, 2000), and Poverty Equivalent Growth Rate (PEGR) (Kakwani and Son, 2008). RG index is an absolute measure, and unlike other absolute measures, it produces a scalar measure of upward mobility with the weight justified by plausible axioms. Moreover, it does not depend on a specific poverty line. [5] [6]

[5] GIC and PGC use stochastic dominance curves, which do not necessarily rely on specific poverty lines. By contrast, GIC, PBG, PPGI, and PEGR investigate the relationship between changes in poverty measures and growth rates to evaluate how growth contributed to the change in the poverty measure.

[6] Son (2007) discussed the monotonicity criterion for pro-poor growth measures, which requires that the extent of poverty reduction should steadily increase with the pro-poor growth rate. This criteria also depends on the poverty line, and only PEGR adheres to this criterion. They argued that the choice of the measure should be context-specific: If the study focuses on measuring the extent of economic growth beneficial to the poor compared to other population groups, then the PPGI is a good measure. If the research question is how much economic growth is needed to reduce poverty levels to a certain threshold, the PEGR is a choice. GIC is a powerful tool for illustrating how economic growth affects the income of various population groups.

2.2 Decomposition

To investigate the factors affecting RG index, we conducted decomposition in two different ways. The first approach divides the population into two subgroups and investigates how RG index can be decomposed into two subgroup RG index. This exercise provides the basis for graphical analyses of the evolution of the upward mobility of subgroups, such as rural and urban households, or ethnic majority and ethnic minorities. This approach does not impose any additional assumptions, but is limited to two subgroups. The second approach decomposes RG index into the part explained by the observable characteristics and the unexplained part, as in the Blinder-Oaxaca decomposition. This requires several assumptions, but is useful for exploring the factors contributing to upward mobility or pro-poor growth. Specifically, we implement aggregate decomposition, which decomposes RG index measure into explained and unexplained parts. Then, with further assumptions, we conduct a detailed decomposition that explores the factors contributing to pro-poor growth.

2.2.1 Subgroup analysis

Consider a population divided into two groups, k and l. Define the relative aggregate weighted baseline income in year s as $W(s) \equiv \frac{\sum_{i\in l} y_i^{-\alpha}(s)}{\sum_{i\in k} y_i^{-\alpha}(s)}$, which is the ratio of total weighted baseline income y^a in each group. We can decompose the exponential of RG index as follows:

$$
\begin{aligned}
\exp(M_\alpha^\Delta(\mathbf{y}(s),\mathbf{y}(t))) &= e^{-\frac{1}{t-s}\frac{1}{\alpha}} \frac{\sum_{i\in k} y_i^{-\alpha}(t) + \sum_{i\in l} y_i^{-\alpha}(t)}{\sum_{i\in k} y_i^{-\alpha}(s) + \sum_{i\in l} y_i^{-\alpha}(s)} \\
&= \frac{e^{-\frac{1}{t-s}\frac{1}{\alpha}} \frac{\sum_{i\in k} y_i^{-\alpha}(t)}{\sum_{i\in k} y_i^{-\alpha}(s)} + \frac{\sum_{i\in l} y_i^{-\alpha}(s)}{\sum_{i\in k} y_i^{-\alpha}(s)} e^{-\frac{1}{t-s}\frac{1}{\alpha}} \frac{\sum_{i\in l} y_i^{-\alpha}(t)}{\sum_{i\in l} y_i^{-\alpha}(s)}}{1 + \frac{\sum_{i\in l} y_i^{-\alpha}(s)}{\sum_{i\in k} y_i^{-\alpha}(s)}} \\
&= \frac{\exp\left(M_{\alpha,k}^\Delta(\mathbf{y}(s),\mathbf{y}(t))\right) + W(s)\exp\left(M_{\alpha,l}^\Delta(\mathbf{y}(s),\mathbf{y}(t))\right)}{1+W(s)},
\end{aligned}
$$

where $M_{\alpha,k}^\Delta(\mathbf{y}(s),\mathbf{y}(t))$ represents RG index for group k. This equation shows that the exponential upward mobility, $\exp\left(M_\alpha^\Delta(\mathbf{y}(s),\mathbf{y}(t))\right)$, is a weighted average of the group-wise exponential upward mobility, with the weight dependent on the weighted baseline income y^a and the group size of each group. Given the group sizes, the greater weight will be assigned to group l if individuals in group l tend to be poorer than group k.

Since $M_\alpha^\Delta(\mathbf{y}(s),\mathbf{y}(t)) = \ln\exp\left(M_\alpha^\Delta(\mathbf{y}(s),\mathbf{y}(t))\right)$, the equation above does not imply that $M_\alpha^\Delta(\mathbf{y}(s),\mathbf{y}(t)) = \frac{M_{\alpha,k}^\Delta(\mathbf{y}(s),\mathbf{y}(t)) + W(s) M_{\alpha,l}^\Delta(\mathbf{y}(s),\mathbf{y}(t))}{1+W(s)}$, as the logarithm is a nonlinear transformation. However, we can compute the contribution ratio of each group's exponential upward mobility to the overall exponential upward mobility as follows:

$$\gamma_{\alpha,k} \equiv \frac{\exp\left(M^{\Delta}_{\alpha,k}(\mathbf{y}(s),\mathbf{y}(t))\right)}{\exp\left(M^{\Delta}_{\alpha,k}(\mathbf{y}(s),\mathbf{y}(t))\right) + W(s)\exp\left(M^{\Delta}_{\alpha,l}(\mathbf{y}(s),\mathbf{y}(t))\right)}, \tag{3}$$

$$\gamma_{\alpha,l} \equiv \frac{W(s)\exp\left(M^{\Delta}_{\alpha,l}(\mathbf{y}(s),\mathbf{y}(t))\right)}{\exp\left(M^{\Delta}_{\alpha,k}(\mathbf{y}(s),\mathbf{y}(t))\right) + W(s)\exp\left(M^{\Delta}_{\alpha,l}(\mathbf{y}(s),\mathbf{y}(t))\right)}. \tag{4}$$

The contributions of each group's upward mobility to the national upward mobility are then given by $\gamma_{\alpha,k}M^{\Delta}_{\alpha}(\mathbf{y}(s),\mathbf{y}(t))$ and $\gamma_{\alpha,l}M^{\Delta}_{\alpha}(\mathbf{y}(s),\mathbf{y}(t))$. [7]

This subgroup analyses requires no additional assumptions, and allows us to link the trajectory of the subgroup RG index to the national RG index. For example, if there is a concern on the rural-urban gap in economic growth, then we can examine if each group achieved pro-poor growth using the subgroup RG index, and then investigate how the group-wise pro-poor growth translated into the national pro-poor growth.

2.2.2 Aggregate decomposition

Next, we consider aggregate decomposition, which decomposes RG index into the parts explained by the observed characteristics and the parts unexplained. To facilitate the explanation, we start with the standard Blinder-Oaxaca decomposition (Blinder, 1973; Oaxaca, 1973) based on regression equation

$$y_i(\tau) = \mathbf{X}_i(\tau)\beta(\tau) + u_i(\tau), \tag{5}$$

[7]This strategy will not work when $M^{\Delta}_{\alpha}(\mathbf{y}(s),\mathbf{y}(t)) = 0$. This happens when

$$\exp\left(M^{\Delta}_{\alpha,k}(\mathbf{y}(s),\mathbf{y}(t))\right) + W(s)\exp\left(M^{\Delta}_{\alpha,l}(\mathbf{y}(s),\mathbf{y}(t))\right) = 1 + W(s).$$

In that case, we can compute the (equal) contribution of each group by

$$\ln\left[\frac{\exp\left(M^{\Delta}_{\alpha,k}(\mathbf{y}(s),\mathbf{y}(t))\right) + W(s)}{1 + W(s)}\right].$$

where $\mathbf{X}_i(\tau)$ is the covariate vector of household i in year $\tau = s, t$ and $u_i(\tau)$ are the error terms that satisfy $E[u_i(\tau)|\mathbf{X}_i(\tau)] = 0$. The change in the mean of y_i

$$\begin{aligned}
\Delta_O^\mu &= E[y_i(t)] - E[y_i(s)] \\
&= E\{E[y_i(t)|\mathbf{X}_i(t)]\} - E\{E[y_i(s)|\mathbf{X}_i(s)]\} \\
&= E[\mathbf{X}_i(t)]\beta(t) - E[\mathbf{X}_i(s)]\beta(s) \\
&= \{E[\mathbf{X}_i(t)] - E[\mathbf{X}_i(s)]\}\beta(t) + E[\mathbf{X}_i(s)](\beta(t) - \beta(s)) \\
&= \Delta_X^\mu + \Delta_S^\mu
\end{aligned}$$

where the first term Δ_X^μ represents the composition effect (explained effect) and the second term Δ_S^μ is the unexplained effect, which is sometimes called the structure effect.

The estimation of the decomposition is straightforward:

$$\begin{aligned}
\hat{\Delta}_O^\mu &= \hat{\Delta}_X^\mu + \hat{\Delta}_S^\mu \\
&= [\bar{\mathbf{X}}(t) - \bar{\mathbf{X}}(s)]\hat{\beta}(t) + \bar{\mathbf{X}}(s)[\hat{\beta}(t) - \hat{\beta}(s)],
\end{aligned}$$

where $\bar{\mathbf{X}}(\tau)$ are the sample averages of the covariates and $\hat{\beta}(\tau)$ are the OLS estimates from equation (5).

We now consider the aggregate decomposition of RG index. From the definition of RG index in equation (1), we can rewrite this measure as

$$\begin{aligned}
\hat{M}_\alpha^\Delta(\mathbf{y}(s), \mathbf{y}(t)) &\equiv \frac{1}{t-s} \ln \left[\frac{\frac{1}{n_t}\sum_{i=1}^{n_t} y_i^{-\alpha}(t)}{\frac{1}{n_s}\sum_{i=1}^{n_s} y_i^{-\alpha}(s)} \right]^{-\frac{1}{\alpha}} \\
&= \frac{1}{t-s} \left\{ \left(-\frac{1}{\alpha} \ln \left[\frac{1}{n_t} \sum_{i=1}^{n_t} y_i^{-\alpha}(t) \right] \right) - \left(-\frac{1}{\alpha} \ln \left[\frac{1}{n_s} \sum_{i=1}^{n_t} y_i^{-\alpha}(s) \right] \right) \right\}
\end{aligned}$$

This means that RG index is the change in the distribution statistic

$$\nu(\mathbf{y}(\tau)) = -\frac{1}{\alpha(t-s)} \ln \left[\frac{1}{n_\tau} \sum_{i=1}^{n_t} y_i^{-\alpha}(\tau) \right]$$

between two time periods. Let the overall change in distributional statistic ν be $\Delta_O^\nu \equiv \nu(\mathbf{y}(t)) - \nu(\mathbf{y}(s))$. By definition, $\hat{M}_\alpha^\Delta(\mathbf{y}(s), \mathbf{y}(t)) = \Delta_O^\nu$.

We decompose RG index into the composition effect (explained effect) and the structure effect (unexplained effect) using the reweighting method proposed by DiNardo et al. (1996). Let $F_{\mathbf{X}(\tau)}$ be the marginal distribution of the characteristics $\mathbf{X}_i$ for year τ, and $F_{y(\tau)|\mathbf{X}(\tau)}$ be the conditional distributions of y in year

τ.

First, consider the counterfactual income distribution in year t with the distribution of the characteristics fixed at baseline year s:

$$F_{y^C(t)}(y) \equiv \int F_{y(t)|\mathbf{X}(t)}(y|X)dF_{\mathbf{X}(s)}(X),$$

where the superscript C stands for the counterfactual. This counterfactual income distribution uses the joint distribution of income and characteristics in year t, but the distribution of the characteristics is the same as that in year s. Utilizing the fact that

$$\int F_{y(t)|\mathbf{X}(t)}(y|\mathbf{X})dF_{\mathbf{X}(s)}(\mathbf{X}) = \int F_{y(t)|\mathbf{X}(t)}(y|\mathbf{X})\Psi(\mathbf{X})dF_{\mathbf{X}(t)}(\mathbf{X})$$

where $\Psi(\mathbf{X}) = \frac{dF_{\mathbf{X}(s)}(\mathbf{X})}{dF_{\mathbf{X}(t)}(\mathbf{X})}$, it is clear that the counterfactual distribution $F_{y^C(t)}(\cdot)$ is simply a reweighted version of the distribution $F_{y(t)}(\cdot)$ using $\Psi(\mathbf{X})$ as the weight. Using $dF_{\mathbf{X}(\tau)}(\mathbf{X}) = Pr(\mathbf{X}|year = \tau)$ and Bayes' rule, $Pr(\mathbf{X}|year = \tau) = \frac{Pr(year=\tau|\mathbf{X})Pr(\mathbf{X})}{Pr(year=\tau)}$, we can rewrite the reweighting factor $\Psi(\mathbf{X})$ as

$$\Psi(\mathbf{X}) = \frac{dF_{\mathbf{X}(s)}(\mathbf{X})}{dF_{\mathbf{X}(t)}(\mathbf{X})} = \frac{\frac{Pr(year=s|\mathbf{X})Pr(\mathbf{X})}{Pr(year=s)}}{\frac{Pr(year=t|\mathbf{X})Pr(\mathbf{X})}{Pr(year=t)}} = \frac{\frac{Pr(year=s|\mathbf{X})}{Pr(year=s)}}{\frac{Pr(year=t|\mathbf{X})}{Pr(year=t)}},$$

These arguments imply that we can construct the counterfactual distribution statistic ν in year t with the distribution of the characteristics fixed at baseline year s as

$$\nu(\mathbf{y}^C(t)) = -\frac{1}{\alpha(t-s)} \ln \left[\frac{1}{n_\tau} \sum_{i=1}^{n_t} \Psi(\mathbf{X}_i(t)) y_i^{-\alpha}(t) \right],$$

and the overall change in the distributional statistic ν, $\Delta_O^\nu = \hat{M}_\alpha^\Delta(\mathbf{y}(s), \mathbf{y}(t))$, can be decomposed as

$$\Delta_O^\nu = \underbrace{\nu(\mathbf{y}(t)) - \nu(\mathbf{y}^C(\tau))}_{\Delta_X^\nu} + \underbrace{\nu(\mathbf{y}^C(\tau)) - \nu(\mathbf{y}(s))]}_{\Delta_S^\nu},$$

where the first term Δ_X^ν represents the composition effect and the second term Δ_S^ν is the structure effect.

Hence, the aggregate decomposition can be implemented using the following procedure:

1. Pool the data for years s and t and run a flexible logit or probit for $Pr(year = s|\mathbf{X})$ (polynomial in $\mathbf{X}$) to get the predicted probability $\hat{Pr}(year = s|\mathbf{X})$ and $\hat{Pr}(year = t|\mathbf{X})$[8].

[8] $\hat{Pr}(year = t|\mathbf{X}) = 1 - \hat{Pr}(year = s|\mathbf{X})$

2. Estimate the reweighting factor $\hat{\Psi}(\mathbf{X})$ by

$$\hat{\Psi}(\mathbf{X}) = \frac{\frac{\hat{Pr}(year=s|\mathbf{X})}{\hat{Pr}(year=s)}}{\frac{\hat{Pr}(year=t|\mathbf{X})}{\hat{Pr}(year=t)}},$$

3. Compute the counterfactual distribution statistic $\nu(\mathbf{y}^C(t))$

$$\hat{\nu}(\mathbf{y}^C(t)) = -\frac{1}{\alpha(t-s)} \ln \left(\sum_{i=1}^{n_t} \hat{\Psi}(\mathbf{X}_i(t)) y_i^{-\alpha}(t) \right).$$

4. Compute the composition effect (explained by the change in $\mathbf{X}$) as $\hat{\nu}(\mathbf{y}(t)) - \hat{\nu}(\mathbf{y}^C(t))$, and the structure effect as $\hat{\nu}(\mathbf{y}^C(t)) - \hat{\nu}(\mathbf{y}(s))$.

Note that the reweighting factor can be extremely large when $\hat{Pr}(year = s|\mathbf{X})$ is close to zero, which deteriorates the performance of the reweighting procedure (Fortin et al., 2011). Including many polynomials makes it more likely that $\hat{Pr}(year = t|\mathbf{X})$ will be close to zero for some observations. To mitigate this problem, we adopted logistic LASSO to choose the polynomials included in the prediction of $Pr(year = s|\mathbf{X})$.

2.2.3 Detailed decomposition

Finally we consider the detailed decomposition that allows us to explore the factors contributing to the pro-poor growth. In the standard Blinder-Oaxaca decomposition, the detailed decomposition is derived from the following expressions:

$$\hat{\Delta}_S^{\mu} = [\hat{\beta}_0(t) - \hat{\beta}_0(s)] + \sum_{k=1}^{M} \bar{X}_k(t)[\hat{\beta}_k(t) - \hat{\beta}_k(s)]$$
$$\hat{\Delta}_X^{\mu} = \sum_{k=1}^{M} [\bar{X}_k(t) - \bar{X}_k(s)]\hat{\beta}_k(s),$$

where $\hat{\beta}_0(t) - \hat{\beta}_0(s)$ represents the omitted group effect, $\bar{X}_k(t)[\hat{\beta}_k(t) - \hat{\beta}_k(s)]$ the contribution of the kth covariate to the composition effect, and $[\bar{X}_k(t) - \bar{X}_k(s)]\hat{\beta}_k(s)$ the contribution of the kth covariate to the wage structure effect.

To conduct the detailed decomposition of RG index, we employ the RIF regression approach proposed by Firpo et al. (2009). They showed that once we obtain the recentered influence function (RIF) of the statistic of interest. then the detailed decomposition can be performed as in the Blinder-Oaxaca decomposition with replacing the dependent variable y by the RIF of that statistics.

For our distributional statistic $\nu(\mathbf{y}(\tau))$, one can show that the RIF is expressed as

$$RIF(y(\tau);\nu) = \nu(\mathbf{y}(\tau)) - \frac{1}{\alpha(t-s)}\left[\frac{y_i(\tau)^{-\alpha} - E(y^{-\alpha})}{E(y^{-\alpha})}\right].$$

With an additional assumption that the conditional expectation of the RIF $RIF(y;\nu)$ is linear in the covariates

$$E[RIF(y(\tau);\nu)|\mathbf{X}(\tau)] = \mathbf{X}(\tau)\gamma(\tau),$$

we can obtain the the detailed decomposition of RG index by the following procedure:

1. Obtain the estimates of $RIF(y;\nu)$,

$$R\hat{I}F(y_j(\tau);\nu) = \nu(\mathbf{y}(\tau)) - \frac{1}{\alpha(t-s)}\left[\frac{y_j(\tau)^{-\alpha} - \frac{1}{n_t}\sum_{i=1}^{n_t} y_i^{-\alpha}(\tau)}{\frac{1}{n_t}\sum_{i=1}^{n_t} y_i^{-\alpha}(\tau)}\right],$$

   and run a linear regression of $R\hat{I}F(y_j(\tau);\nu)$ on $\mathbf{X}(\tau)$ to get the estimates of $\gamma(\tau)$ for year $\tau = s, t$, denoted by $\hat{\gamma}_\tau$.

2. The detailed decomposition can be obtained as

$$\hat{\Delta}_O^\nu = \bar{\mathbf{X}}_t(\hat{\gamma}_t - \hat{\gamma}_s) + (\bar{\mathbf{X}}_t - \bar{\mathbf{X}}_s)\hat{\gamma}_s,$$

   where the second term represents the detailed decomposition of the composition effect

$$(\bar{\mathbf{X}}_t - \bar{\mathbf{X}}_s)\hat{\gamma}_s = \sum_{k=1}^{K}(\bar{X}_{k,t} - \bar{X}_{k,s})\hat{\gamma}_{k,s} \tag{6}$$

   and the first term the structure effect

$$\bar{\mathbf{X}}_t(\hat{\gamma}_t - \hat{\gamma}_s) = \sum_{k=1}^{K}\bar{X}_{k,t}(\hat{\gamma}_{k,t} - \hat{\gamma}_{k,s}). \tag{7}$$

   Contribution of the change in k-th variable to RG index is obtained by $(\bar{X}_{k,t} - \bar{X}_{k,s})\hat{\gamma}_{k,s}$.

Note that the RIF approach can also be used for the aggregate decomposition, where the composition effect is computed by the left-hand side of equation (6) and the structure effect by the left-hand side of equation (7). While the reweighting approach takes a flexible functional form in computing the reweighting factor, the RIF requires a stronger assumption of the linearity of the conditional expectation of the RIF.

3 Data

We utilized data from the Vietnam Household Living Standard Survey (VHLSS) to compute RG index and conduct decomposition analyses. The VHLSS is a nationally representative survey with stratified random sampling, conducted biennially since 2002, with the latest data available for 2020. An important feature of the VHLSS is its consistency in the questionnaire, which allows us to precisely compute RG index over relatively long periods based on household data.

We calculated upward mobility over 6-year, 10-year, and 18-year periods using household per capita expenditure and income, adjusting for inflation using the GDP deflator.[9] To account for sampling variation, we computed the standard errors for RG index by bootstrapping clustered by commune (the primary sampling unit).

Due to the disproportionate weight given to the poor, RG index is sensitive to sampling errors, as the sample minimum is not a consistent estimator of the population minimum. Therefore, we winsorize y_i at 1th and 99th percentiles because the percentiles are consistent estimators.

For decomposition analyses, we use the following variables as covariates $\mathbf{X}$: indicators for ethnic minorities, rural residents, and working in the agricultural sector; ratio of employed household members; dependency ratio; indicators for the education level of the household head (no degree, primary, lower secondary, upper secondary, and above); and an indicator for households with members who completed college or higher education.

To examine the importance of regional economic development in RG index, we computed the average agricultural revenue of farming households from the VHLSS as a proxy for the productivity of the agricultural sector. We also include industrial output and gross domestic product (GDP) at the provincial level obtained from the Statistical Yearbook of the General Statistical Office of Vietnam.

[9] Inflation adjustment is crucial for valid estimates of RG index since it depends on growth rates, though the decomposition analyses will be little affected. We also used the CPI for inflation adjustment, but the results were similar.

4 Result

4.1 Upward mobility over time

First, we computed RG index over 6-year intervals from 2002 to 2020. Figure 1 shows the trend of RG index (blue solid lines) for $\alpha \in \{0.1, 0.3, 0.5, 1.0, 2.0\}$. As a reference, we also present the trend in average per capita growth, which corresponds to $\alpha = 0$. We use per capita expenditure in panel (A) and per capita income in panel (B) to compute RG index. The dotted lines indicate the 95% confidence intervals computed using wild-cluster bootstrapping. The narrow confidence intervals suggest that the sampling survey could provide accurate estimates of upward mobility.

Reflecting sustained economic growth during this period, RG index of per capita expenditure consistently takes positive values. The choice of parameter value α has little effect on the trajectory of RG index. Because a larger α places more weight on the income growth of the poor, the insensitivity of RG index to α suggests that the poor benefited from economic growth as the non-poor and supports the argument that Vietnam has achieved equitable economic growth. The result that the relative upward mobility (red solid lines) is close to zero also implies that the income distribution had not worsened for the poor during this period.

The upward mobility of per capita income also recorded positive values throughout the survey periods, although the trend differs slightly from that of per capita expenditure. The similar trends of average per capita expenditure and income growth to those of RG index suggest that the different trajectories are due to household consumption responses to income changes.

Note that RG index, like any measures of change, depends on the performance of the baseline year. Consequently, RG index will appear high if per capita expenditure or income in the baseline year was unfavorable to poor households. To mitigate sensitivity to different baseline years, we plot RG index using 2002 as the baseline year in Figure 2. Compared to Figure 1, the values of RG index are more stable. The figure indicates that Vietnam has steadily achieved pro-poor growth since 2002, especially after 2010.

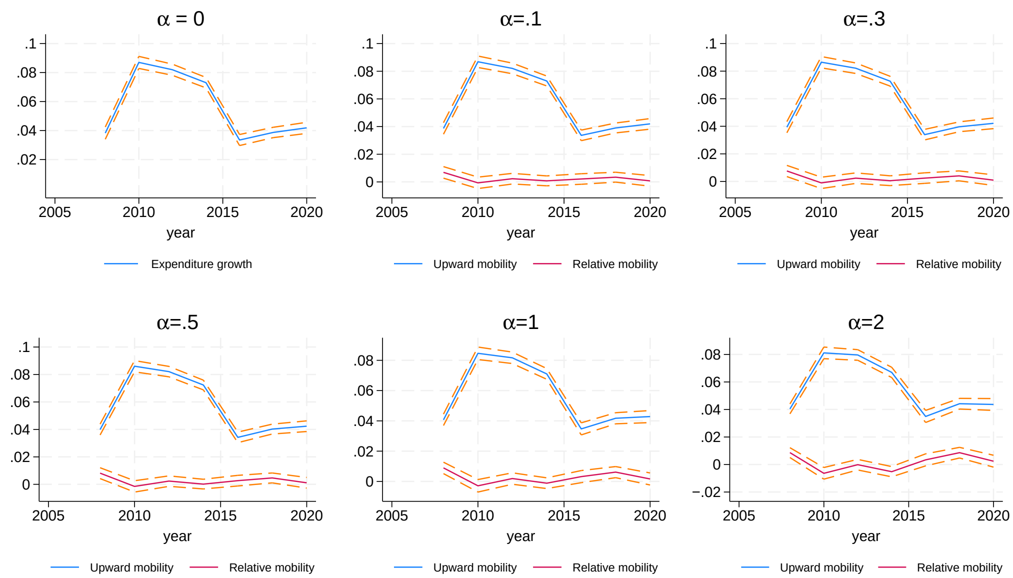
4.2 Upward mobility across subgroups

Next, we conducted several subgroup analyses. Since the economic laggedness of ethnic minorities and the rural-urban gap are of concern (Benjamin et al., 2017; Bank, 2022), we conducted a subgroup analysis for (a) ethnic majority vs. ethnic minorities and (b) urban residents vs. rural residents.

Figure 3 depicts RG index of ethnic majority (blue lines) and ethnic minorities (red lines) for $\alpha = 0.5$. The vertical bars indicate the 95% confidence intervals computed using wild-cluster bootstrapping. RG index was lower for ethnic minorities than for the ethnic majority in earlier periods, indicating that ethnic

Figure 1: Upward mobility and Relative upward mobility

(A) Expenditure per capita



(B) Income per capita

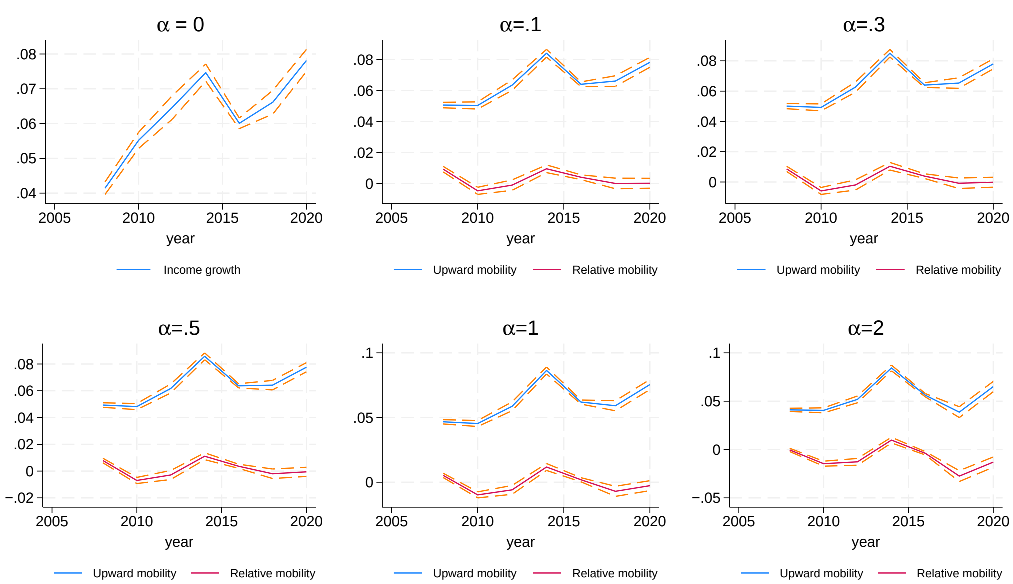
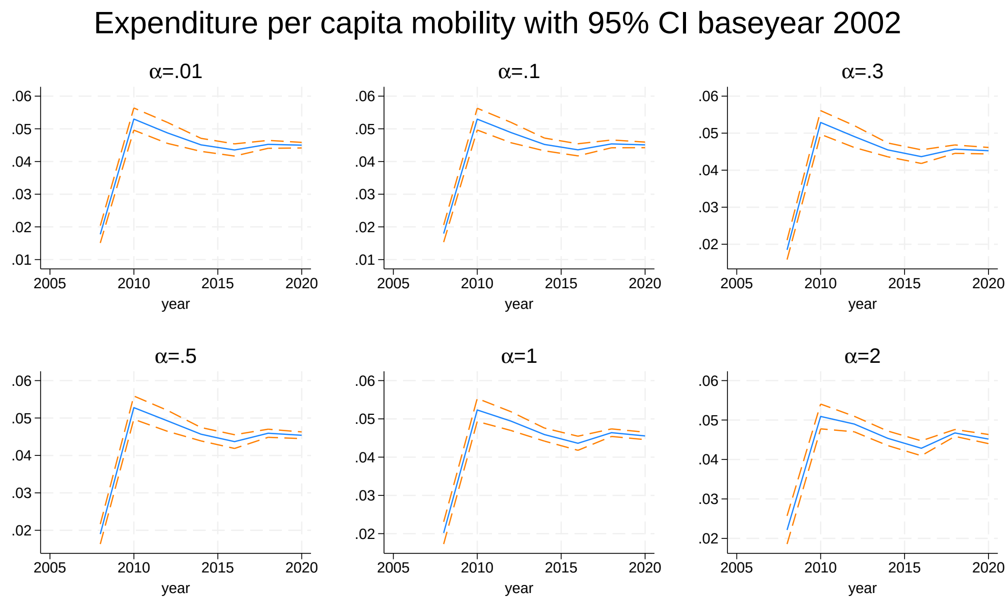
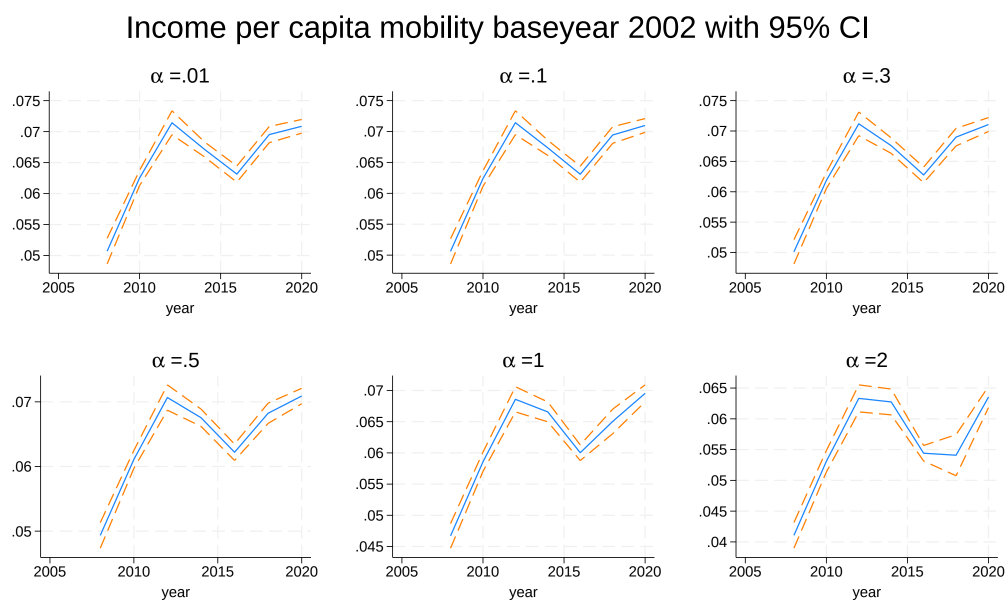


Figure 2: Upward and relative upward mobility with base year 2002

(A) Expenditure per capita

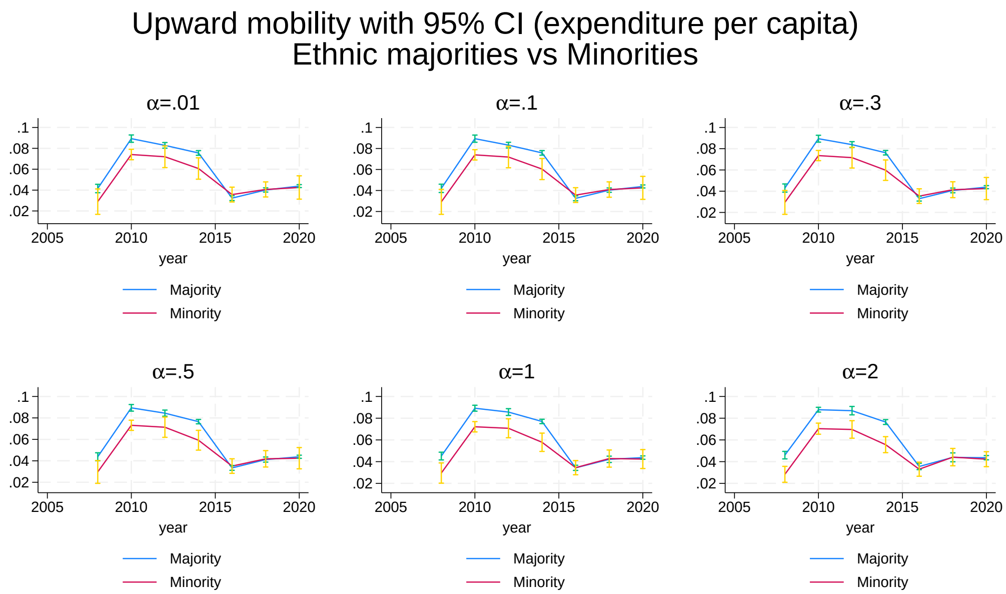


(B) Income per capita



minorities were left behind in the national economic growth. However, in recent periods, RG index of ethnic minorities has increased to a level similar to that of the ethnic majority, implying that economic growth has become more inclusive.

Figure 3: Subgroup analysis: ethnic majority vs ethnic minority, rural vs urban



	(1) Upward mobility (UM)	(2) UM: majority	(3) UM: minority	(4) $n_{minority,s}/n_{majority,s}$	(5) $W(s)$	(6) $\gamma_{majority}$	(7) $\gamma_{minority}$
2008-2002	0.0405	0.0438	0.0296	0.1637	0.2083	0.8296	0.1704
2010-2004	0.0850	0.0894	0.0731	0.1802	0.2406	0.8086	0.1914
2012-2006	0.0821	0.0845	0.0713	0.1717	0.2265	0.8173	0.1827
2014-2008	0.0724	0.0765	0.0592	0.1779	0.2385	0.8101	0.1899
2016-2010	0.0316	0.0334	0.0351	0.2094	0.2781	0.7821	0.2179
2018-2012	0.0404	0.0411	0.0419	0.1839	0.2421	0.8050	0.1950
2020-2014	0.0448	0.0438	0.0424	0.1615	0.2173	0.8217	0.1783

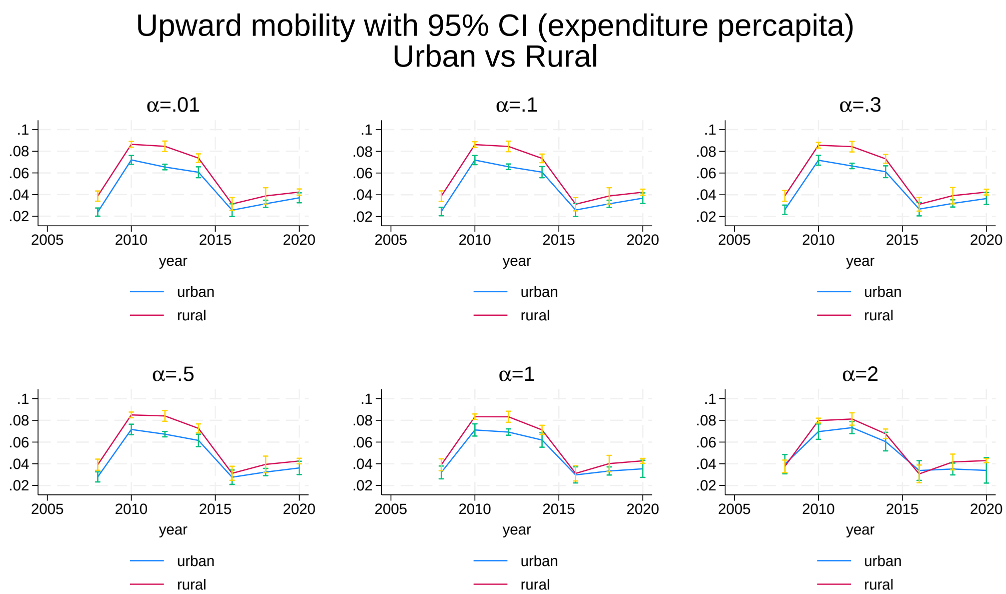
As expressed in equations (3)-(4), the contribution to RG index depends on the relative aggregate weighted baseline income $W(s)$, which also depends on the size of the group. In columns (4) and (5), we report the ratio of minority group to the majority group (minority-majority ratio) in the baseline year s sample and the weight $W(s)$. In all the years, the weight $W(s)$ is greater than the minority-majority ratio, reflecting their lower baseline livings standards.

The last two columns in the table presented in Figure 3, $\gamma_{majority}$ and $\gamma_{minority}$, shows the contribution of each group's RG index to national RG index. The results indicate that the ethnic minority's contribution to the improvement in RG index ($\gamma_{minority}$) was greater than that of the ethnic majority ($\gamma_{majority}$). This is because ethnic minorities tended to be poorer in the baseline years, resulting in a greater weight $W(s)$

for them. The increased upward mobility among ethnic minorities in recent years has resulted in a greater contribution to national RG index.

Figure 4 shows RG index of the rural and urban residents. Throughout the study period, RG index was slightly higher in the rural areas, indicating that rural regions experienced more pro-poor growth. Since rural residents tended to be poorer in the baseline years, their contribution of the RG index improvement to the national RG index improvement (γ_{rural}) was greater than that of urban residents (γ_{urban}).

Figure 4: Subgroup analysis: rural vs urban



	(1) Upward mobility (UM)	(2) UM: urban	(3) UM: rural	(4) $n_{rural,s}/n_{urban,s}$	(5) $W(s)$	(6) γ_{urban}	(7) γ_{rural}
2008-2002	0.0405	0.0279	0.0391	2.6640	3.4622	0.2222	0.7778
2010-2004	0.0850	0.0716	0.0850	2.4612	3.1906	0.2362	0.7638
2012-2006	0.0821	0.0673	0.0841	2.4376	3.0958	0.2411	0.7589
2014-2008	0.0724	0.0615	0.0726	2.2872	2.8753	0.2559	0.7441
2016-2010	0.0316	0.0276	0.0312	2.2849	2.9304	0.2537	0.7463
2018-2012	0.0404	0.0324	0.0395	2.0366	2.5322	0.2817	0.7183
2020-2014	0.0448	0.0362	0.0425	1.7551	2.1647	0.3146	0.6854

These two subgroup analyses demonstrate that Vietnam achieved pro-poor growth by increasing the economic status of poor ethnic minorities and rural residents. If the major interest is pro-poor growth performance within and between two subgroups, the subgroup analyses provide clear insights.

4.3 Aggregate decomposition

We now conduct aggregate decomposition analyses using the reweighting approach explained in Section 2.2.2. We decompose RG index into the composition effect that captures the change in covariates $\mathbf{X}$ and the structure effect, which captures the part not explained by the composition effect.

Figure 5 shows the result of the decomposition of RG index over 6-year intervals for different values of α, where we use the per capita expenditure in Panel (A) and per capita income in Panel (B). The figures show quite different patterns between the case using the average change in the log outcome ($\alpha = 0$) and the case using RG index ($\alpha > 0$). In particular, while the decomposition based on the average log growth ($\alpha = 0$) reveals the significant role of the composition effect, especially after 2016, the decomposition based on RG index shows a very limited role of the composition effects in these periods. As we put more weight on the expenditure r income growth of the poor (larger value of α), the improvement of RG index has been predominantly driven by the structure effects. These results imply that the impressive experience of the pro-poor growth in Vietnam was not due to the improvement of household characteristics, but due to the expenditure and income growth given household characteristics.

The difference in the decomposition results between the average log growth and RG index stems from the disproportional weight on the poor in RG index. When using the log average log growth ($\alpha = 0$), the expenditure or income growth rate of the rich is counted equally with that of the poor. However, as α increases, less weight is placed on the growth of the rich, and RG index predominantly reflects the variations in the outcome of the poor. If the demographic composition of the poor did not change over time, then we would observe small composition effects in RG index.

Figure 6 illustrates the relationship between the weighted outcome ($\hat{\Psi}(\mathbf{X}_i)y_i^{-\alpha}$) and actual outcome ($y^{-\alpha}$) for 2020 across different values of α. Because the composition effect is computed as $\hat{\nu}(\mathbf{y}(t)) - \hat{\nu}(\mathbf{y}^C(t))$, a greater correlation between the weighted and actual outcomes corresponds to a smaller composition effect. The figure shows that as α increases, the correlation between the weighted outcome and actual outcome increases, indicating the limited role of the composition effects on pro-poor growth. This pattern is primarily driven by the fact that the poorest (left in the distribution in panel (A) and right in the distribution in panel (B)) tend to have less discrepancy between the weighted outcome and actual outcome, which indicates that the demographic characteristics of the poorest did not considerably change over time.

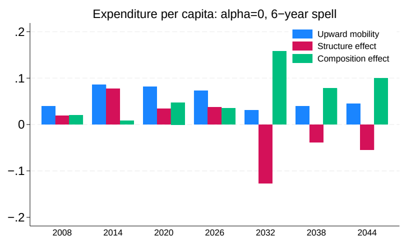
One might be concerned that the small contribution of the composition effect is due to examining RG index over only 6-year intervals, as household demographics may not change significantly in a short period.[10] To investigate the variation in household demographics over time, we report the means for each variable for

[10]Using repeated cross-section data, as we did, would alleviate this concern.

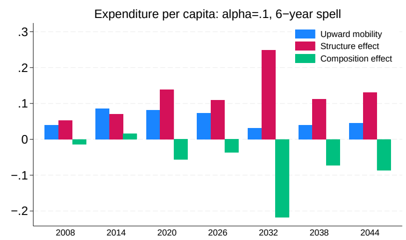
Figure 5: Aggregate decomposition (reweighting approach): over 6 years

(A) Per capita expenditure

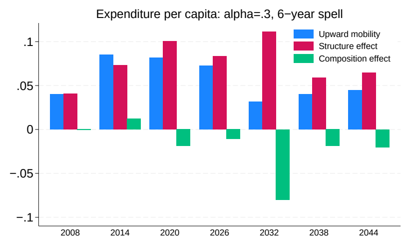
(a) $\alpha = 0$ (average growth of $ln(y)$)



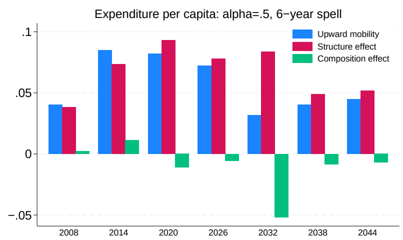
(b) $\alpha = 0.1$



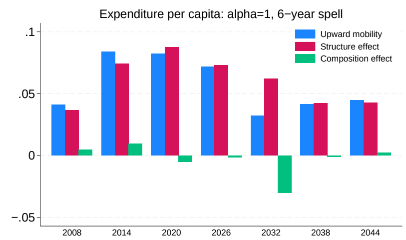
(c) $\alpha = 0.3$



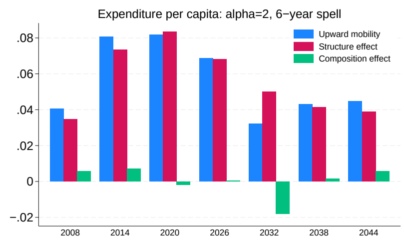
(d) $\alpha = 0.5$



(e) $\alpha = 1$

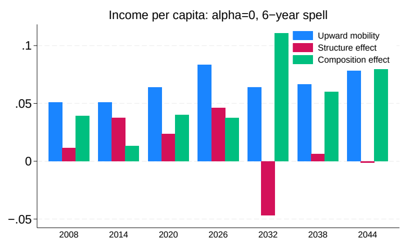


(f) $\alpha = 2$

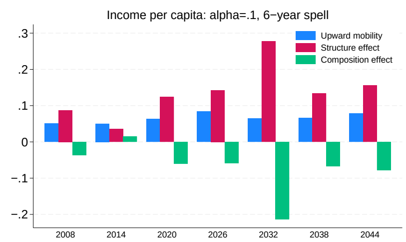


(B) Per capita income

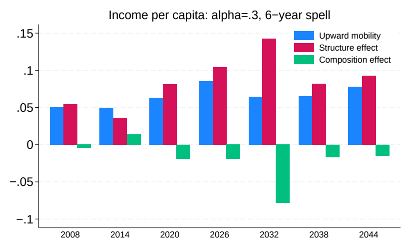
(a) $\alpha = 0$ (average growth of $ln(y)$)



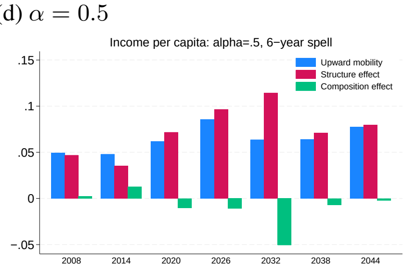
(b) $\alpha = 0.1$



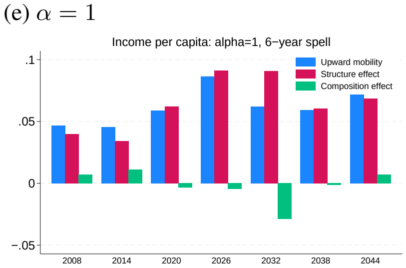
(B) $\alpha = 0.3$



(d) $\alpha = 0.5$



(e) $\alpha = 1$



(f) $\alpha = 2$

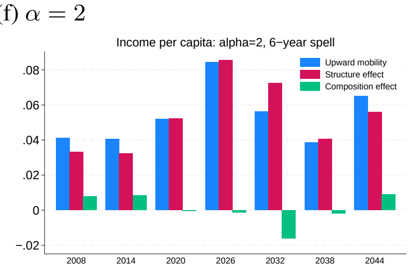
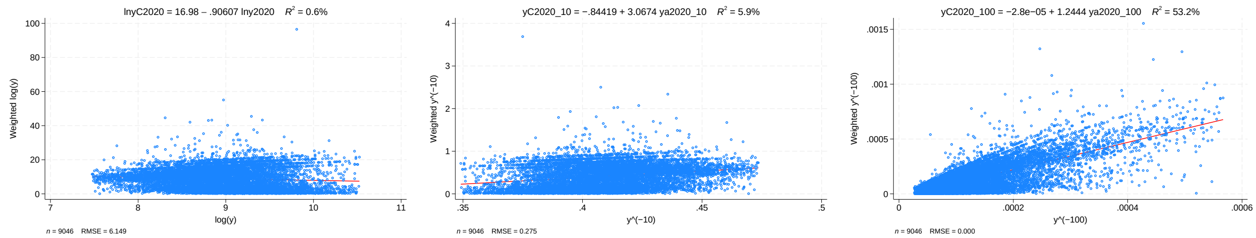


Figure 6: Actual y and counterfactual y: per capita expenditure

(A) $\alpha = 0$ (B) $\alpha = 0.1$ (B) $\alpha = 1$



each year in Table 1, and graphically show the trend in Figure 7 with each variable standardized by the value in 2002 (i.e., the score of variable x_k in year t is computed as $\frac{x_{k,t} - \bar{x}_{k,2002}}{SD(x_{k,2002})}$). Looking at the change over 18 years, the rural dummy fell from 0.768 to 0.639, and the agricultural job dummy declined from 0.7222 to 0.515, reflecting the structural change over two decades. The proportion of households whose heads have completed upper secondary education doubled, and the proportion of households whose members have completed tertiary education tripled. Hence, household demographics changed over time to some extent, but this change was not the main driver of the observed pro-poor growth.

Table 1: Mean of covariates

	2002	2004	2006	2008	2010	2012	2014	2016	2018	2020
Minority	0.132	0.143	0.152	0.147	0.162	0.150	0.157	0.183	0.172	0.147
Rural	0.768	0.743	0.732	0.725	0.708	0.710	0.697	0.696	0.673	0.638
Ratio of employed	0.570	0.585	0.584	0.586	0.589	0.596	0.595	0.592	0.587	0.577
Agricultural jobs	0.773	0.748	0.716	0.686	0.642	0.645	0.651	0.636	0.597	0.508
Dependency rate	0.354	0.334	0.312	0.305	0.307	0.306	0.309	0.318	0.326	0.331
Head edu: primary	0.248	0.257	0.265	0.270	0.266	0.256	0.253	0.255	0.255	0.246
Head edu: lower second	0.261	0.284	0.299	0.274	0.284	0.292	0.299	0.298	0.296	0.294
Head edu: upper second	0.082	0.121	0.125	0.094	0.146	0.154	0.158	0.151	0.164	0.193
Head edu: tertiary	0.088	0.041	0.043	0.105	0.057	0.061	0.064	0.072	0.088	0.092
Any tertiary education	0.073	0.091	0.094	0.107	0.128	0.153	0.125	0.192	0.223	0.190
Ratio: completed upper secondary	0.051	0.081	0.092	0.102	0.109	0.065	0.066	0.063	0.125	0.154
Ratio: completed tertiary education	0.052	0.030	0.032	0.037	0.046	0.029	0.033	0.035	0.083	0.070
Average Agr revenue	2.770	3.423	4.388	4.775	5.778	6.107	5.952	6.868	6.932	5.294
ln(Prov. Ind. output)	8.022	8.176	8.338	8.531	8.832	8.968	9.005	8.989	9.177	9.356
ln(Provincial GDP)	6.097	6.306	6.503	6.648	6.971	7.068	7.160	7.251	7.367	7.430
Observations	27182	8658	8785	43901	45844	8743	8991	45321	8974	9214

Additionally, we conduct a similar decomposition over ten years and 18 years, the results of which are presented in Figures 8 and 9, respectively. Note that the 18-year horizon (from 2002 to 2020) is the longest time horizon in our dataset. These figures still show that while the composition effects played a non-negligible role in explaining per capita expenditure or income growth ($\alpha = 0$) in recent periods, their impact on pro-poor growth ($\alpha > 0$) was still limited, even for longer time horizons.

Figure 7: Mean of covariates

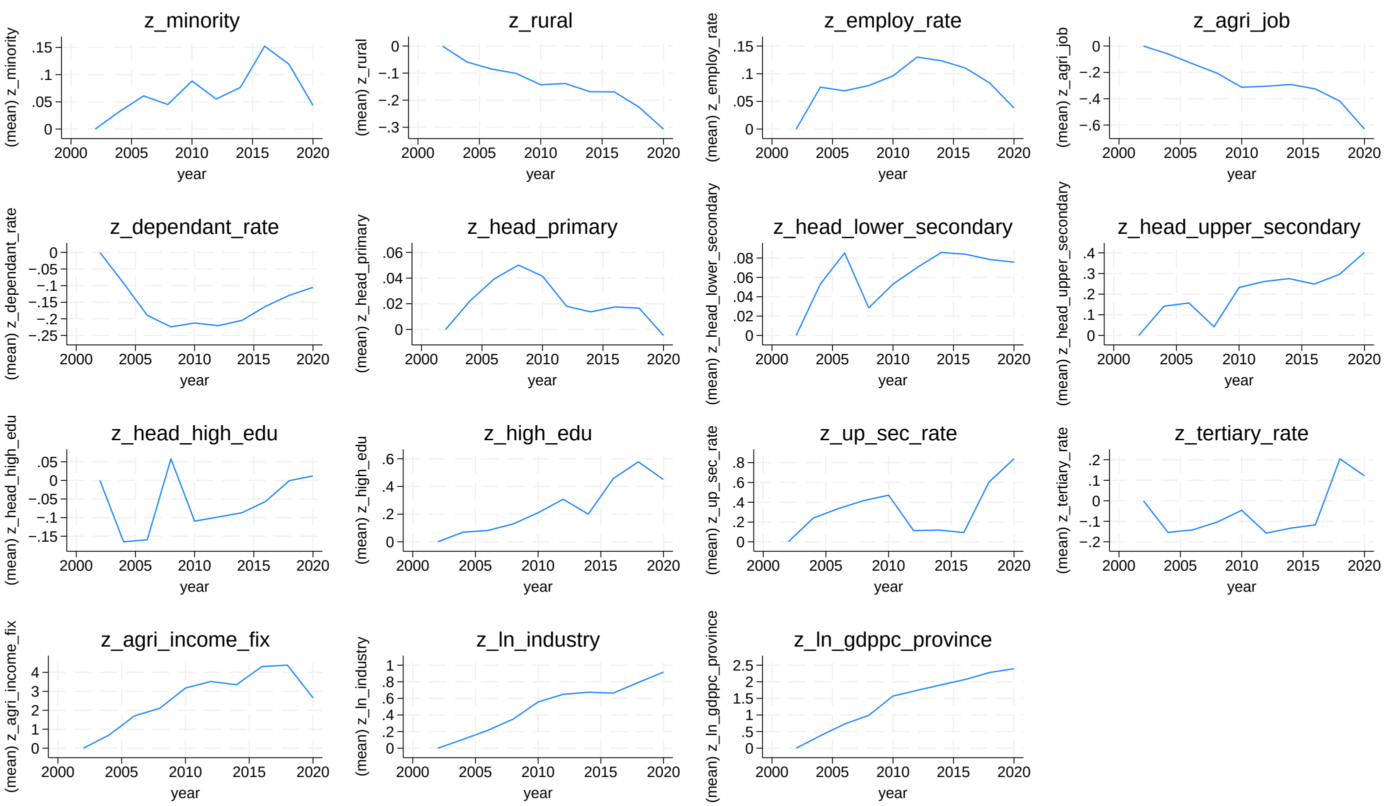
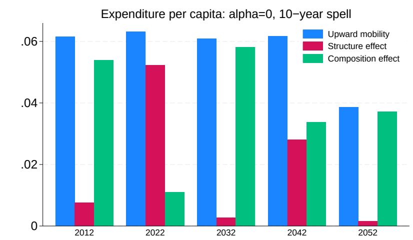


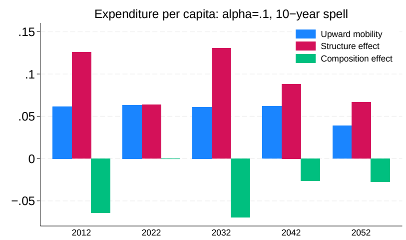
Figure 8: Aggregate decomposition (reweighting approach): over 10 years

(A) Per capita expenditure

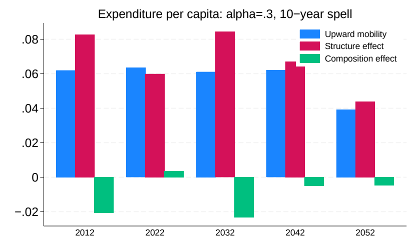
(a) $\alpha = 0$ (average growth of $ln(y)$)



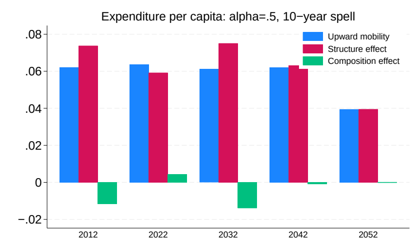
(b) $\alpha = 0.1$



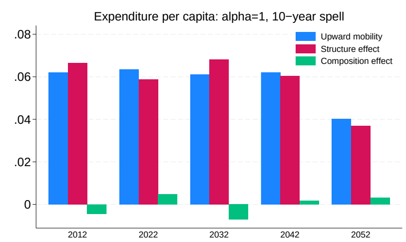
(c) $\alpha = 0.3$



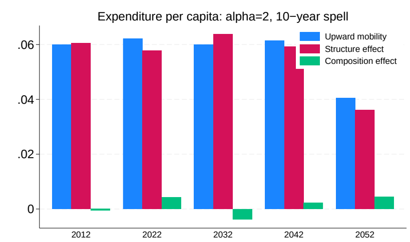
(d) $\alpha = 0.5$



(e) $\alpha = 1$

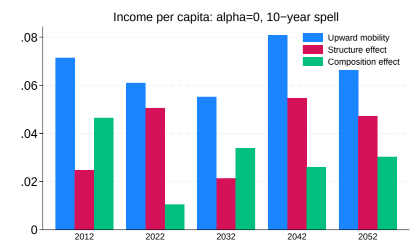


(f) $\alpha = 2$

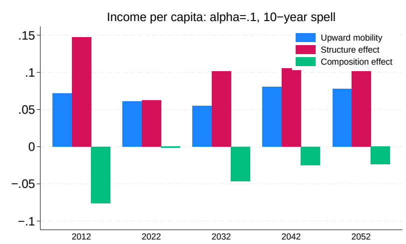


(B) Per capita income

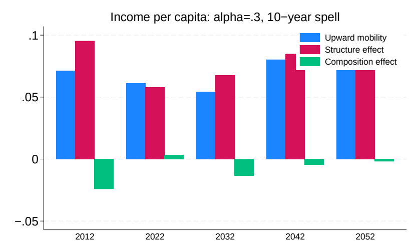
(a) $\alpha = 0$ (average growth of $ln(y)$)



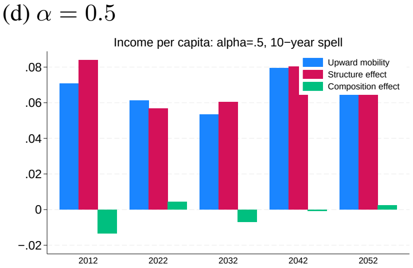
(b) $\alpha = 0.1$



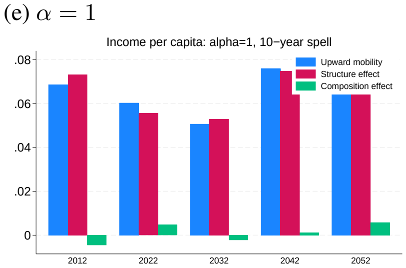
(c) $\alpha = 0.3$



(d) $\alpha = 0.5$



(e) $\alpha = 1$



(f) $\alpha = 2$

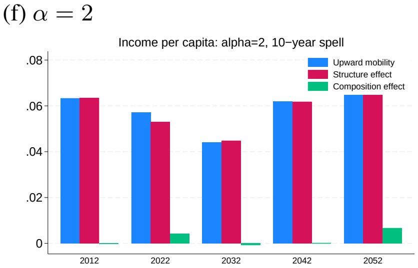
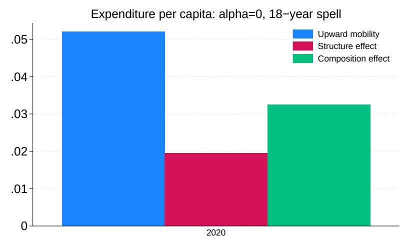


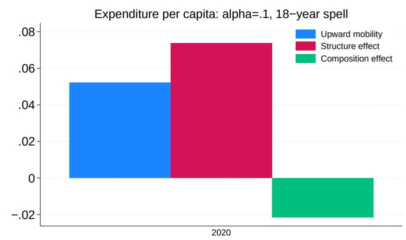
Figure 9: Aggregate decomposition (reweighting approach): over 18 years

(A) Per capita expenditure

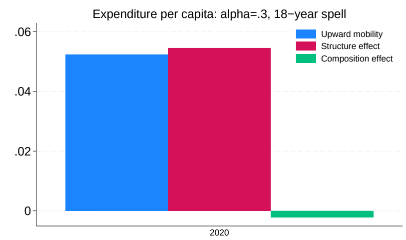
(a) $\alpha = 0$ (average growth of $ln(y)$)



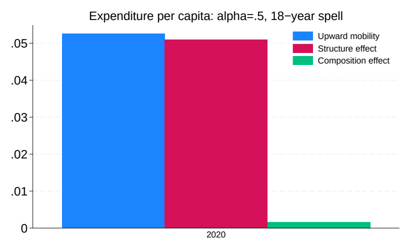
(b) $\alpha = 0.1$



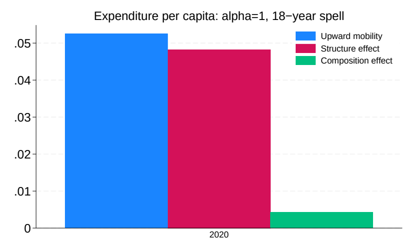
(c) $\alpha = 0.3$



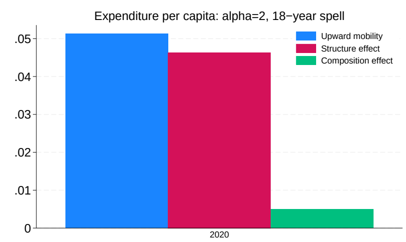
(d) $\alpha = 0.5$



(e) $\alpha = 1$

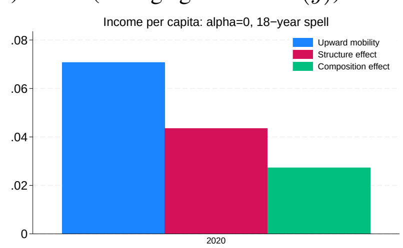


(f) $\alpha = 2$

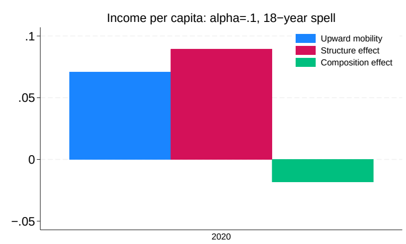


(B) Per capita income

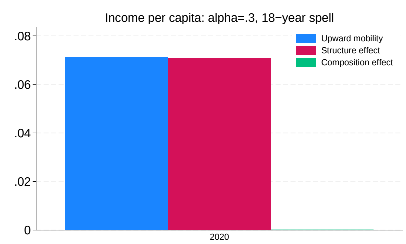
(a) $\alpha = 0$ (average growth of $ln(y)$)



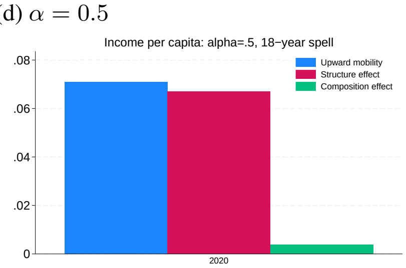
(b) $\alpha = 0.1$



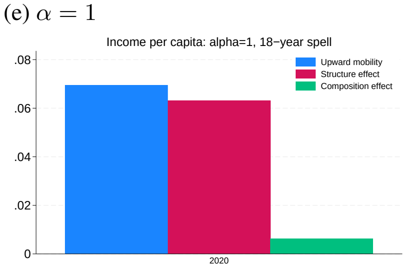
(c) $\alpha = 0.3$



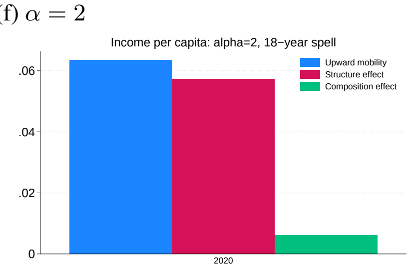
(d) $\alpha = 0.5$



(e) $\alpha = 1$



(f) $\alpha = 2$



We also conduct the aggregate decomposition using the RIF regression approach. Although the reweighting approach is generally preferable for aggregate decomposition because it does not require the linearity assumption inherent in the RIF regression approach, there are two reasons for including the RIF-regression-based aggregate decomposition in our analysis. First, incorporating region-level variables, such as provincial GDP and industrial activities, is straightforward in the RIF approach. This allows us to investigate the impact of local economic activity on pro-poor growth. While it is possible to include region-level variables in the reweighting methods, the flexible form of the reweighting function makes it less suitable reliable due to resultant very small and large values of the reweighting factor $\Psi(\mathbf{X}) = \frac{\frac{Pr(year=s|\mathbf{X})}{Pr(year=s)}}{\frac{Pr(year=t|\mathbf{X})}{Pr(year=t)}}$. Second, comparing the results of the RIF regression approach with those of the reweighting approach serves as a credibility check for the validity of the detailed decomposition based on the RIF regression.

Figure 10 presents the aggregate decomposition results of RG index of per capita expenditure (panel (A)) and per capita income (panel (B)) over 6-year intervals using the RIF regression approach.[11] In panels (A1) and (B1), we include the same variables as in the reweighting approach above. The comparison of the results to those of Figure 5 serves as a credibility check for the RIF regression approach. In panels (A2) and (B2), we additionally include provincial-level variables such as the logarithm of provincial GDP per capita, the logarithm of provincial industrial output, and the average agricultural revenue of households engaging in agricultural activity at the provincial level. For brevity, we only report the results for $\alpha = \{0, 0.5, 2\}$, where $\alpha = 0$ corresponds to the average change in the log outcome.

It should be noted that the decomposition results for $\alpha = 0$ show significant differences between the reweighting approach and the RIF regression approach. The RIF regression approach yields similar decomposition results for various values of α. This is likely due to the linear conditional mean assumption imposed in the RIF regression approach. While the results of the reweighting approach indicated that the demographic characteristics of the poorest have not changed considerably over time, the linear conditional assumption of the RIF regression approach fails to account for these heterogeneous patterns depending on the value of y. Hence, the results of the RIF regression, especially for $\alpha = 0$, should be interpreted with caution.

Including the provincial-level variables significantly altered the decomposition results, particularly for the earlier periods. When these variables are considered, the improvement in upward mobility from 2002 to 2008 is entirely explained by the composition effect. This highlights the crucial role of regional economic development in fostering inclusive economic growth. However, the significance of the composition effect diminishes over time, even after accounting for the provincial-level variables.[12]

Figure 11 presents the results of a similar exercise for RG index over 18-year intervals. The magnitude of

[11] Estimation results of the RIF regression for each year are presented in Appendix Tables **??**-6.

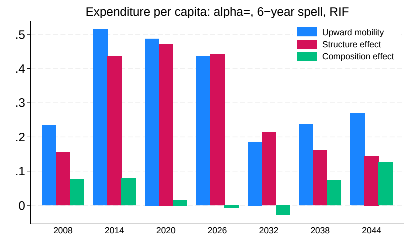
[12] Appendix Figure 1 presents the results for 10-year intervals, showing similar results.

Figure 10: Aggregate decomposition using the RIF regression approach: over 6 years

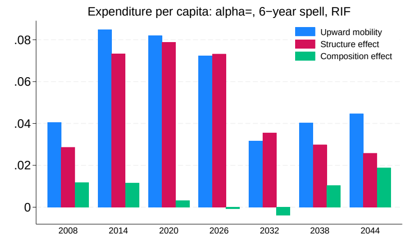
(A) Per capita expenditure

(A1) No regional variables

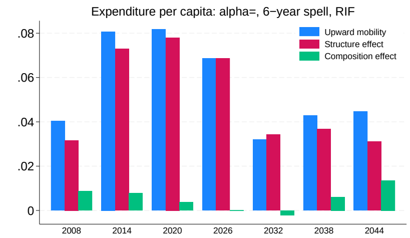
(a) $\alpha = 0$



(b) $\alpha = 0.5$

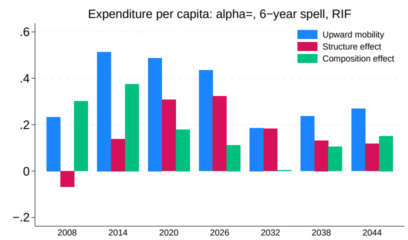


(c) $\alpha = 2$

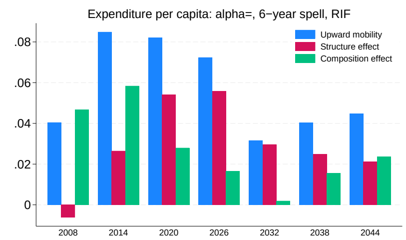


(A2) With regional variables

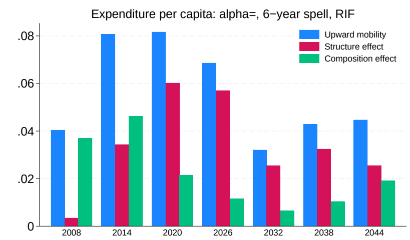
(a) $\alpha = 0$



(b) $\alpha = 0.5$



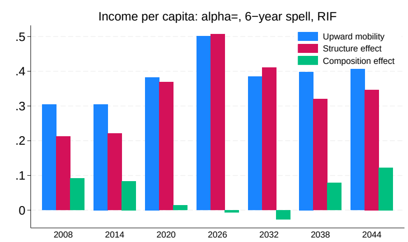
(c) $\alpha = 2$



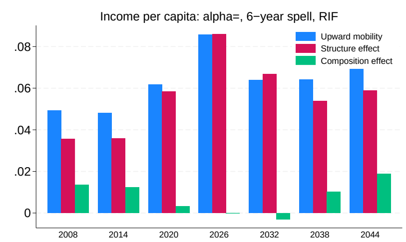
(B) Per capita income

(B1) No regional variables

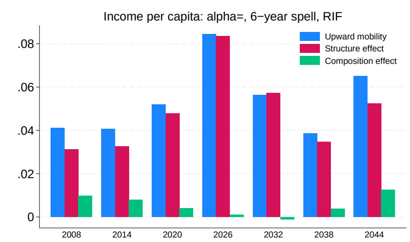
(a) $\alpha = 0$



(b) $\alpha = 0.5$

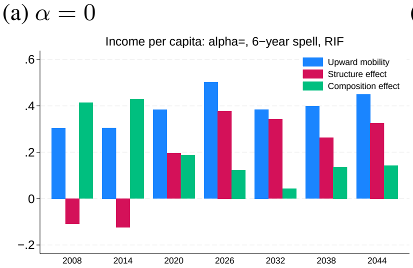


(c) $\alpha = 2$

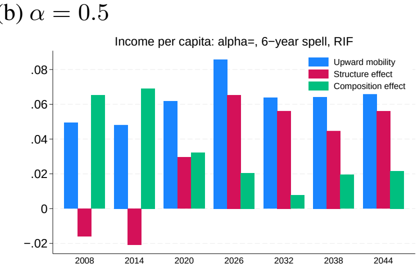


(B2) With regional variables

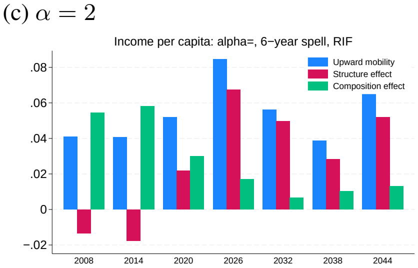
(a) $\alpha = 0$



(b) $\alpha = 0.5$



(c) $\alpha = 2$



the composition effect increases when regional variables are include, although its effect is modest reflecting the greater role of structure effects in the later periods. It is important to note that this does necessarily imply that macro economic environment played a smaller role. Rather, the regional variables capture only the variation across regions, while the national economic growth effect is accounted for as the structural effect (unexplained effect).

4.4 Detailed decomposition

Finally, we present the results of the detailed decomposition. Figure 12 illustrates the composition effect for each variable when $\alpha = 0.5$. Panel (A) illustrates the results for RG index of per capita expenditure, and panel (B) for RG index of per capita income. It is evident that provincial-level variables, namely average agricultural income, industrial output, and GDP per capita, played a major role in the composition effects.[13]

The decomposition presented in Figure 12 is too detailed, making it difficult to determine which set of factors were important contributors to pro-poor growth, especially with many dummy variables for education. For ease of interpretation, we categorized these demographic and regional variables into education-related variables (household head ’ s education level and the indicator for households whose members completed college or higher education), other household characteristics (ethnic minority, rural residence, working in the agricultural sector, ratio of employed household members, and dependency ratio), and provincial-level variables (average agricultural revenue of farming households, industrial output, and gross domestic products) and computed the composition effects of these subcategory variables.

Figure 13 reports the results of this subcategory decomposition when $\alpha = 0.5$, where we take 6-year intervals in panel (I) and 10-year intervals in panel (II).[14] Along with the composition effects of education-related variables (red bars), other household characteristics (green bars), and province-level variables (yellow bars), the RG index values (blue bars) are reported for reference. The figure shows the very limited role of the composition effects of education-related variables and other household characteristics and the importance of provincial economic development, especially in the early periods. While the average educational attainment improved throughout the period, as presented in Table 1 and Figure 7, their contribution to pro-poor growth is limited. In order to facilitate pro-poor growth and improve the living standard of the poor, regional economic development is much more important.[15]

[13]The structure effect in the detailed decomposition is presented in Appendix Figure 2. The large negative value of the structure effect of GDP per capita in 2014 was driven by the smaller coefficient on the provincial GDP per capita in the RIF regression in 2014 compared to that in the base year 2008 (see Appendix Table 2).

[14]The results when $\alpha = 0$ (average change in the log outcome) and $\alpha = 2$ are presented in Appendix Figures **??** and 4, respectively, and exhibit patterns similar to those in Figure 13.

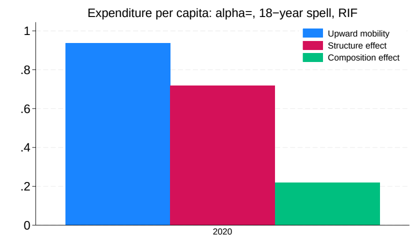
[15]The Appendix Figure 5 illustrates the return effect for each subcategory. In later periods, when the composition effect of provincial-level variables was small, the return effect of provincial-level variables was large, underscoring the importance of the

Figure 11: Aggregate decomposition using the RIF regression approach: over 18 years

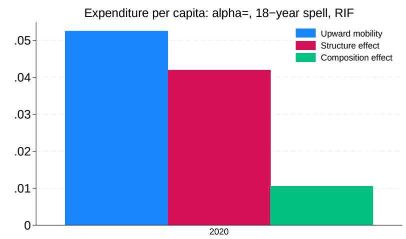
(A) Per capita expenditure

(A1) No regional variables

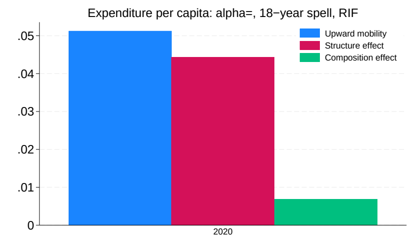
(a) $\alpha = 0$



(b) $\alpha = 0.5$

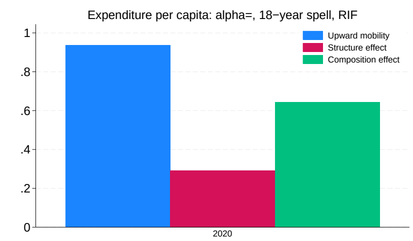


(c) $\alpha = 2$

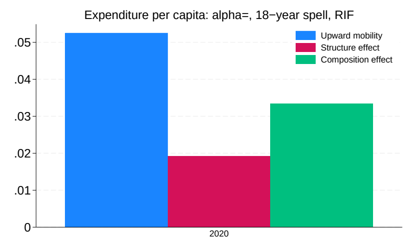


(A2) With regional variables

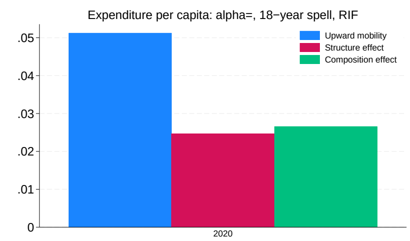
(a) $\alpha = 0$



(b) $\alpha = 0.5$



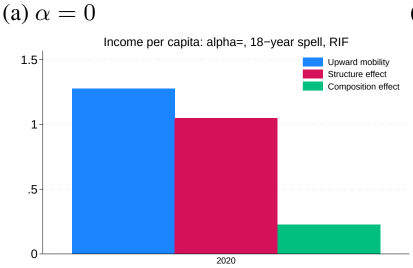
(c) $\alpha = 2$



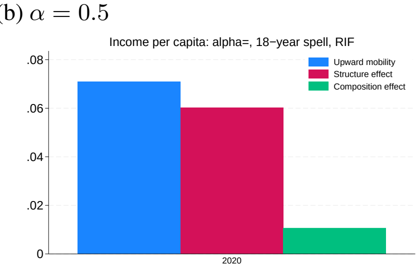
(B) Per capita income

(B1) No regional variables

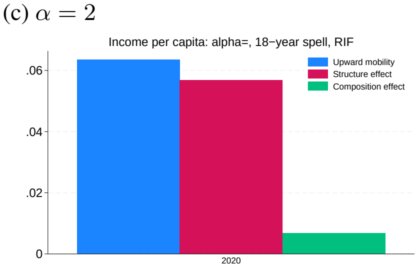
(a) $\alpha = 0$



(b) $\alpha = 0.5$

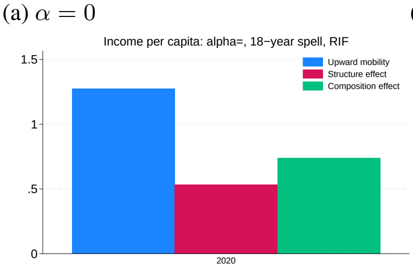


(c) $\alpha = 2$

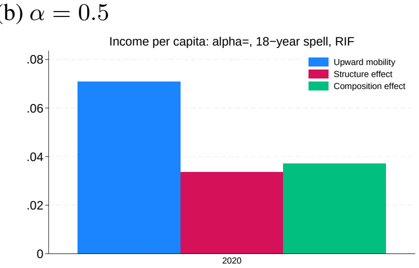


(B2) With regional variables

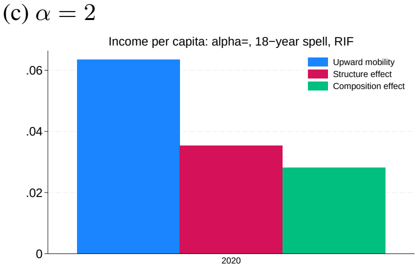
(a) $\alpha = 0$



(b) $\alpha = 0.5$



(c) $\alpha = 2$



5 Concluding Remarks

We conducted decomposition analyses of pro-poor growth in Vietnam using the novel upward mobility measure proposed by Ray and Genicot (2023). While Vietnam has achieved pro-poor growth, particularly in rural areas, the impact of changes in household demographics, such as increased educational attainment and a shift to non-agricultural jobs, was quite limited. A large fraction of pro-poor growth can be attributed to favorable macroeconomic conditions.

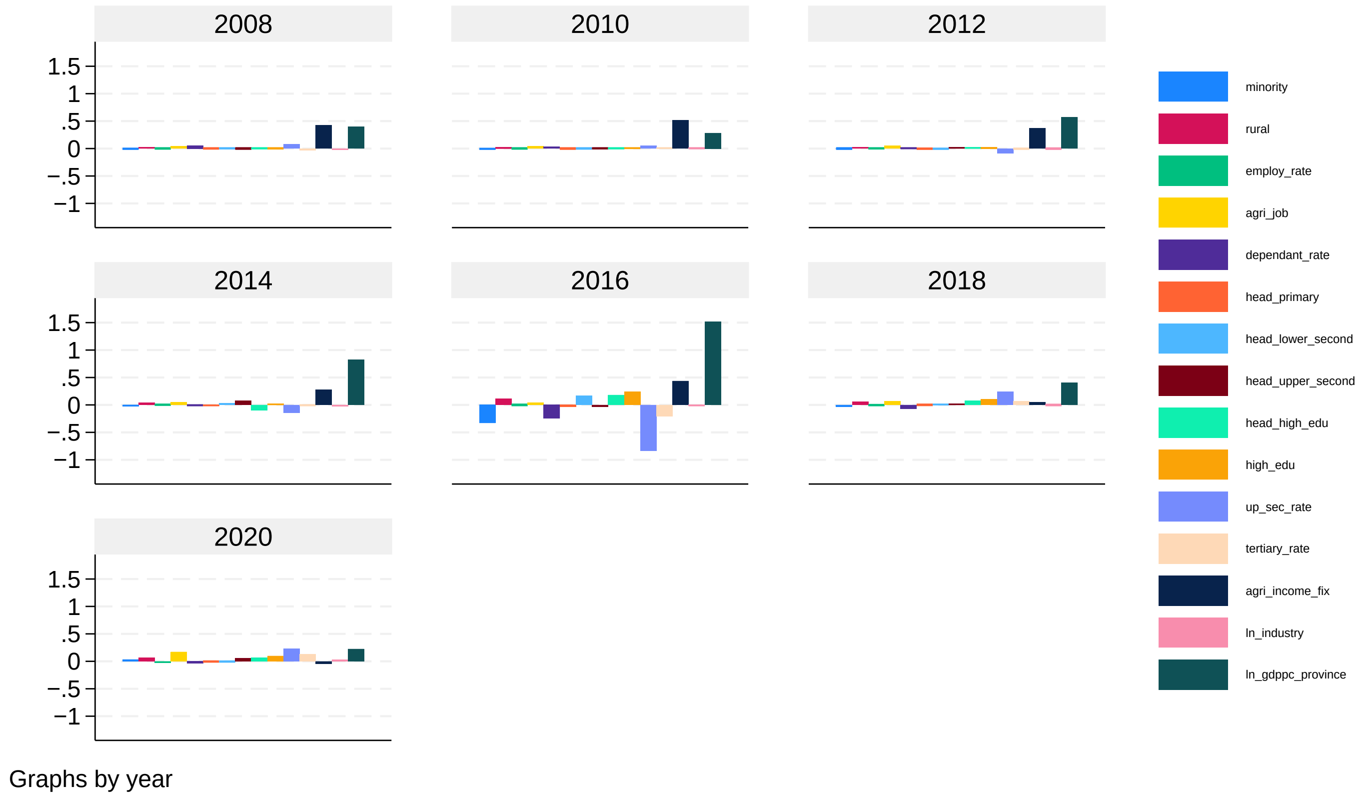
These findings are consistent with growth accounting results, which highlight the importance of TFP growth and the relatively smaller effects of human capital accumulation. Despite the relatively high internal rate of return to education, improvements in educational attainment alone are insufficient to achieve pro-poor growth. Favorable macroeconomic conditions played a more crucial role in driving aggregate economic growth.

However, pro-poor growth in recent periods remains largely unexplained by the composition effects of regional economic variables and household characteristics. While the unexplained part contains national-evel economic growth, further studies are needed to identify additional factors contributing to pro-poor growth.

macroeconomic environment.

Figure 12: Detailed decomposition of per capita expenditure upward mobility ($\alpha = 0.5$)

(A) Per capita expenditure



(B) Per capita income

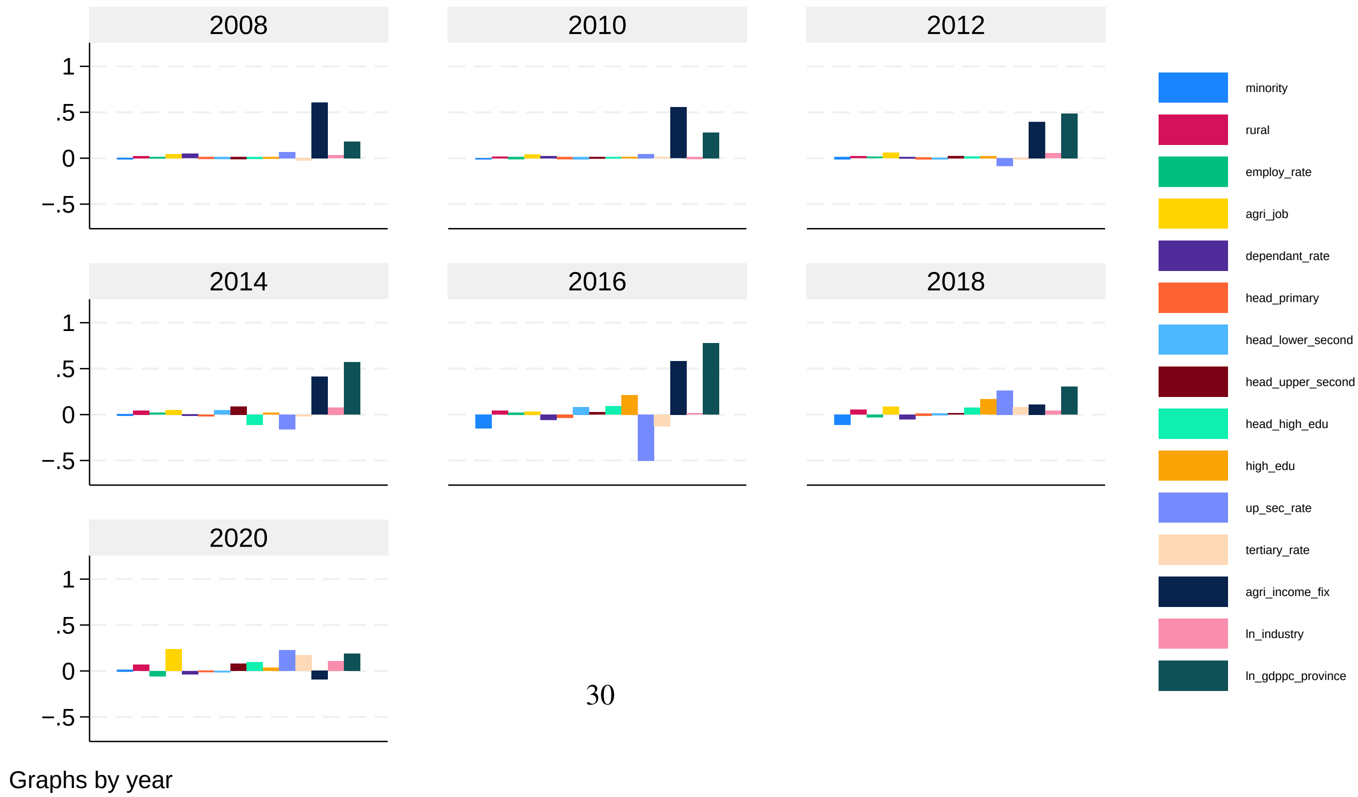
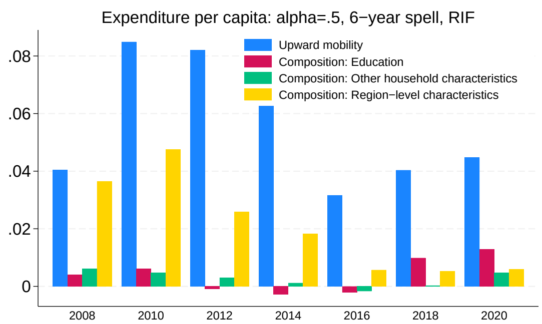


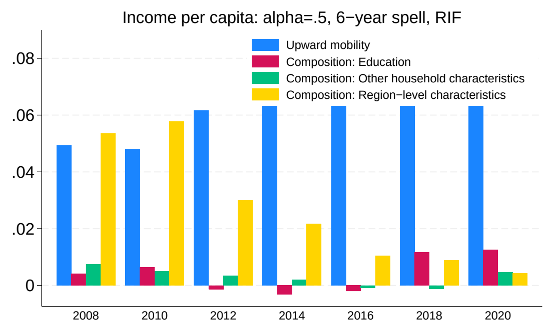
Figure 13: Composition effects by categories ($\alpha = 0.5$)

(I) 6-year intervals

(A) Per capita expenditure

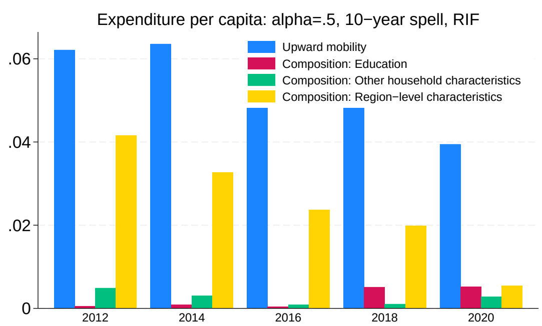


(B) Per capita income

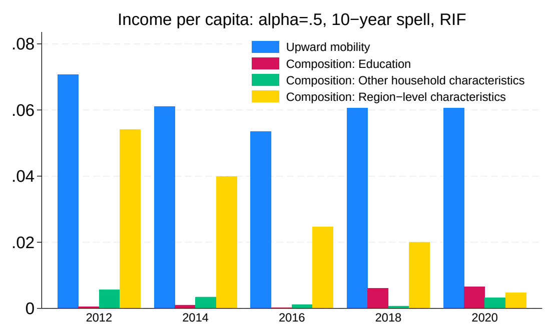


(II) 10-year intervals

(A) Per capita expenditure



(B) Per capita income



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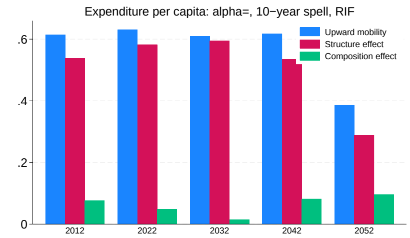
A Appendix Figures and Tables

Appendix Figure 1: Aggregate decomposition using the RIF regression approach: over 10 years

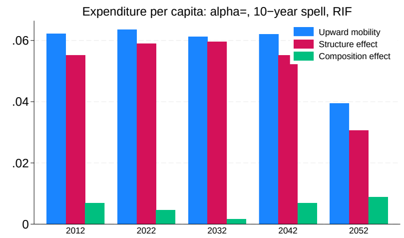
(A) Per capita expenditure

(A1) No regional variables

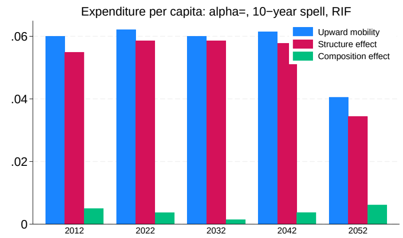
(a) $\alpha = 0$



(b) $\alpha = 0.5$

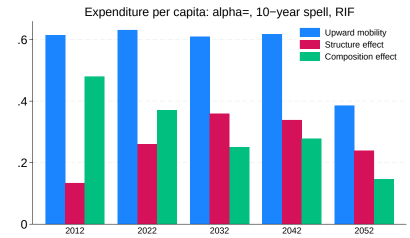


(c) $\alpha = 2$

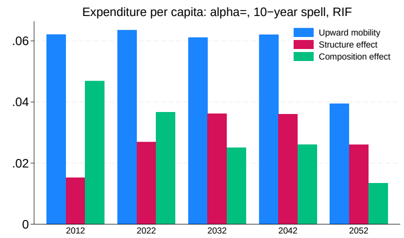


(A2) With regional variables

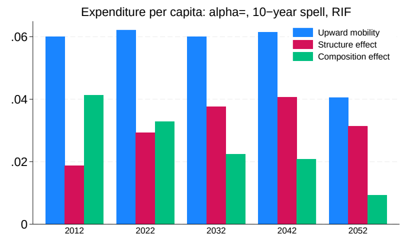
(a) $\alpha = 0$



(b) $\alpha = 0.5$



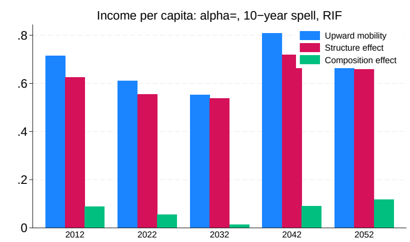
(c) $\alpha = 2$



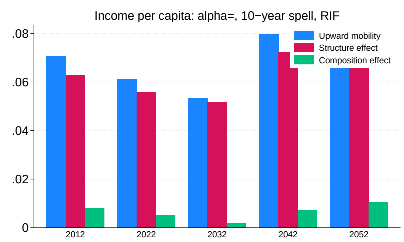
(B) Per capita expenditure

(B1) No regional variables

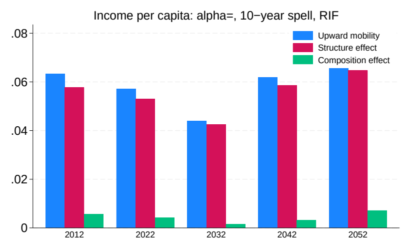
(a) $\alpha = 0$



(b) $\alpha = 0.5$

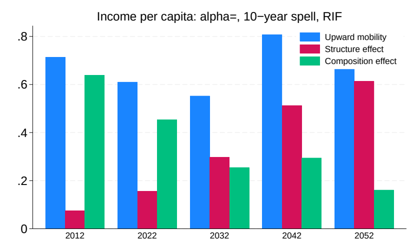


(c) $\alpha = 2$

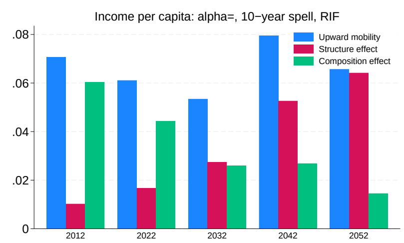


(B2) With regional variables

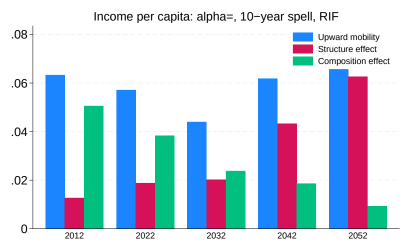
(a) $\alpha = 0$



(b) $\alpha = 0.5$

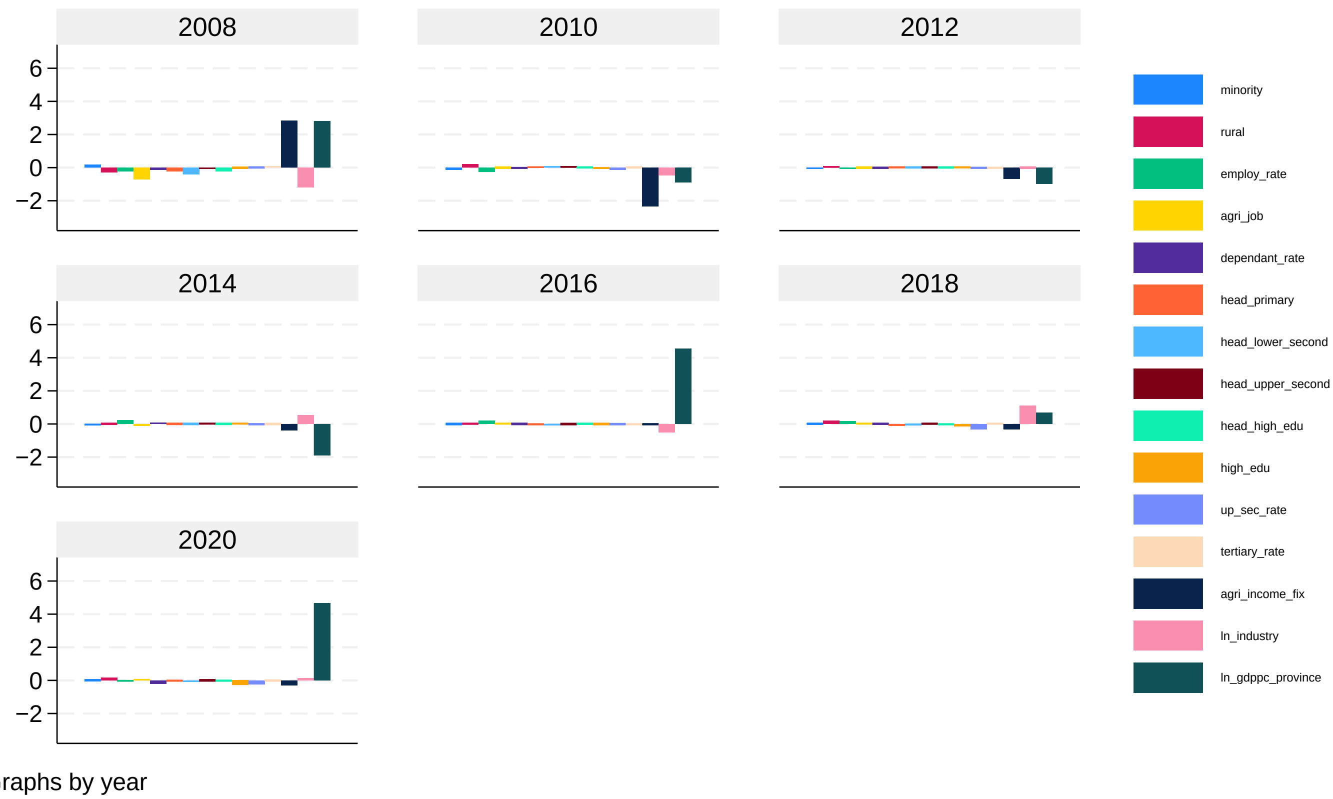


(c) $\alpha = 2$

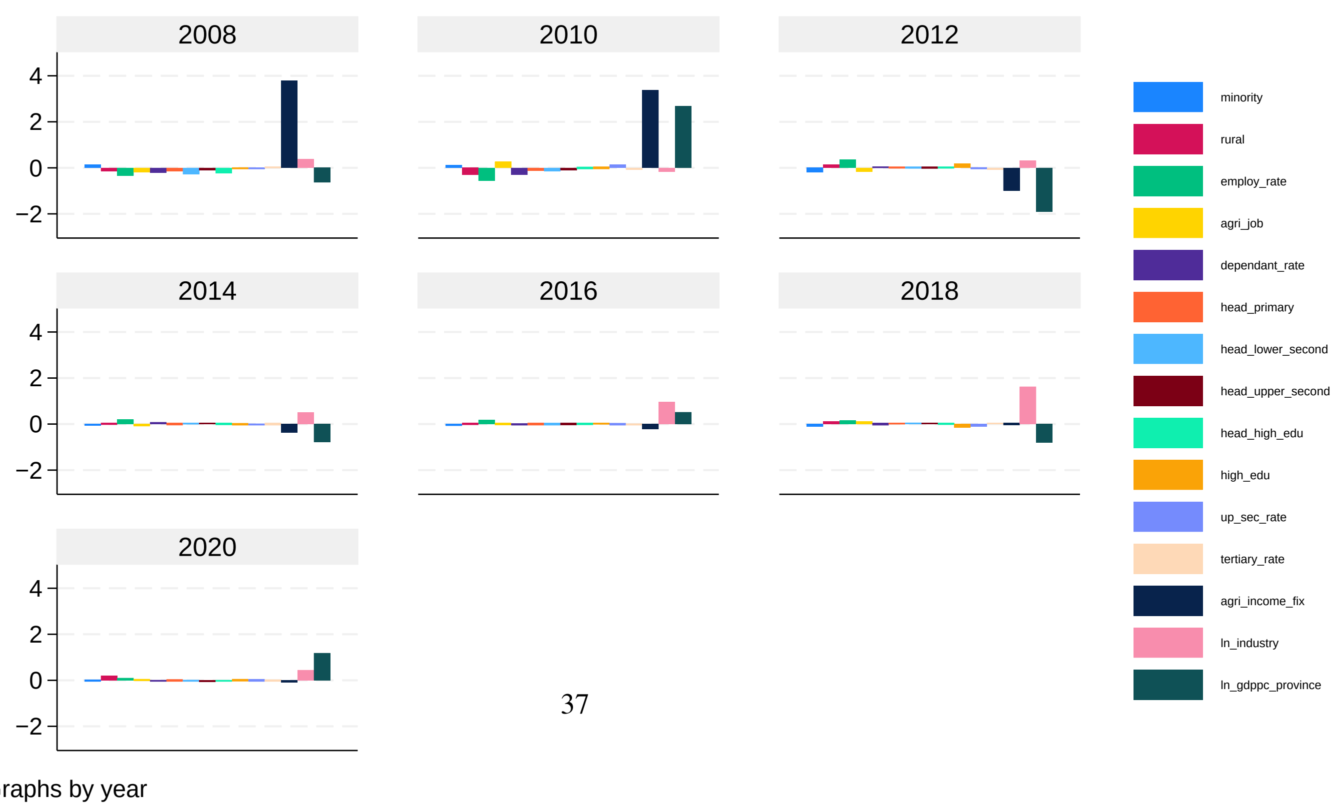


Appendix Figure 2: Structure effects in detailed decomposition ($\alpha = 0.5$)

(A) Per capita expenditure



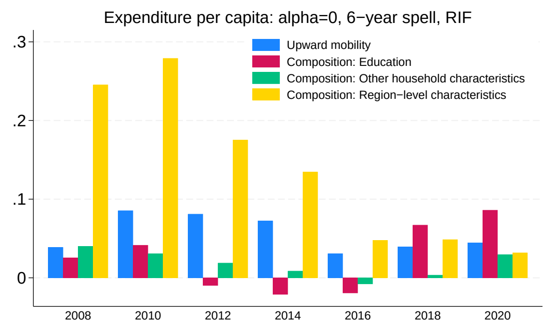
(B) Per capita income



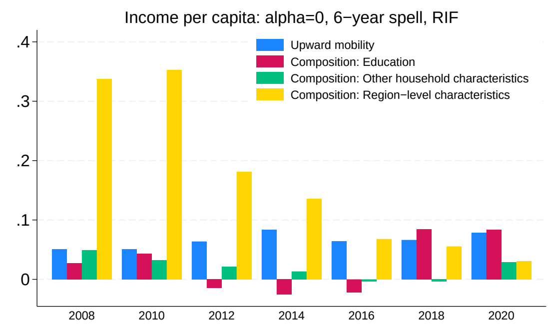
Appendix Figure 3: Composition effects by categories: $\alpha = 0$ (average change in log outcome)

(I) 6-year intervals

(A) Per capita expenditure

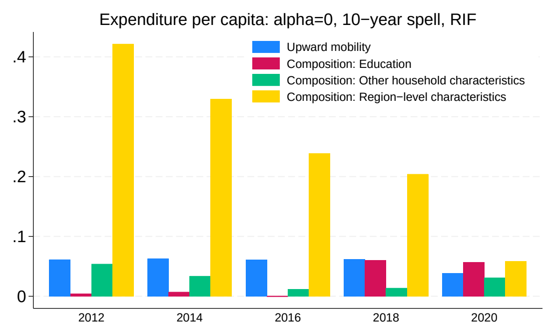


(B) Per capita income

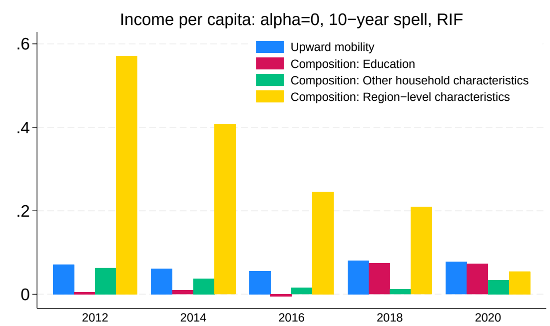


(II) 10-year intervals

(A) Per capita expenditure



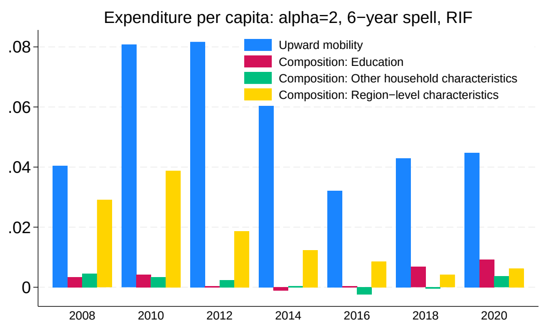
(B) Per capita income



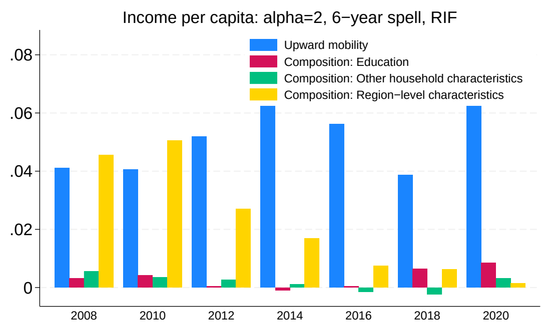
Appendix Figure 4: Composition effects by categories: $\alpha = 2$

(I) 6-year intervals

(A) Per capita expenditure

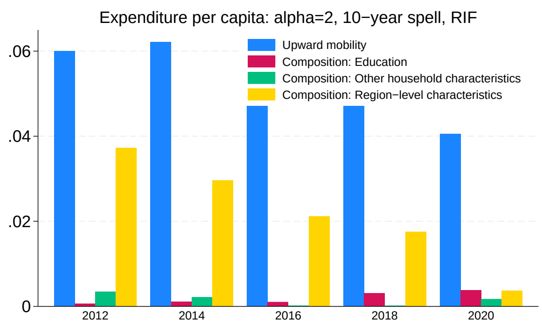


(B) Per capita income

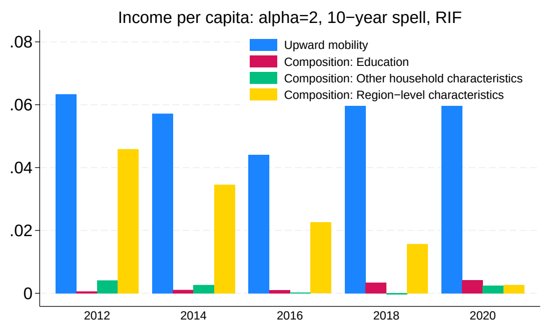


(II) 10-year intervals

(A) Per capita expenditure



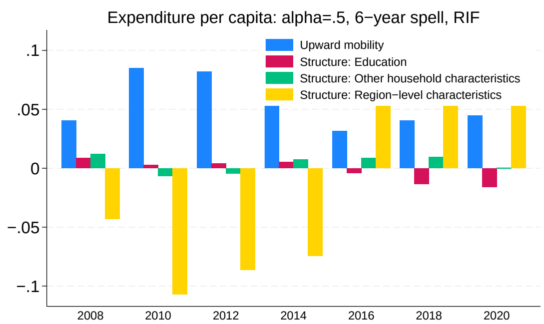
(B) Per capita income



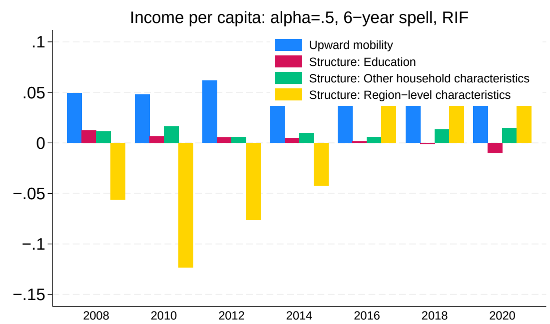
Appendix Figure 5: Structure effects by categories: $\alpha = 0.5$

(I) 6-year intervals

(A) Per capita expenditure

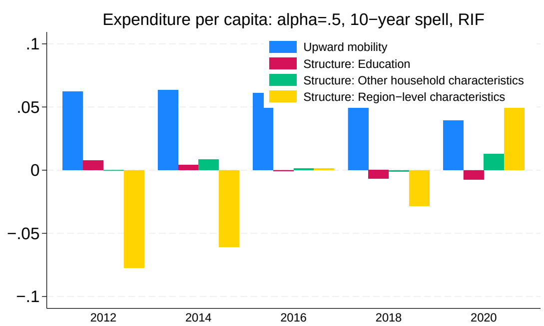


(B) Per capita income

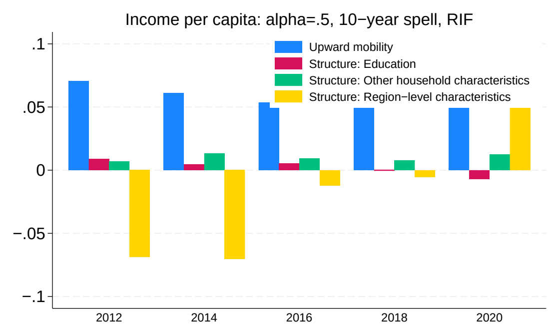


(II) 10-year intervals

(A) Per capita expenditure



(B) Per capita income



Appendix Table 1: RIF regression for expenditure per capita: $\alpha = 0$ (average change in the log outcome)

(A) Without regional variables:

	(1) lny2002	(2) lny2004	(3) lny2006	(4) lny2008	(5) lny2010	(6) lny2012	(7) lny2014	(8) lny2016	(9) lny2018	(10) lny2020
Minority	-0.234***	-0.296***	-0.285***	-0.304***	-0.358***	-0.359***	-0.390***	-0.371***	-0.354***	-0.377***
	(0.013)	(0.016)	(0.016)	(0.015)	(0.015)	(0.016)	(0.015)	(0.016)	(0.015)	(0.016)
Rural	-0.240***	-0.276***	-0.252***	-0.217***	-0.207***	-0.201***	-0.177***	-0.208***	-0.164***	-0.168***
	(0.014)	(0.017)	(0.017)	(0.017)	(0.015)	(0.015)	(0.014)	(0.016)	(0.014)	(0.013)
Ratio of employed	0.013	0.089***	0.086***	0.062**	0.046*	0.070**	0.181***	0.096***	0.088***	0.168***
	(0.023)	(0.029)	(0.029)	(0.028)	(0.027)	(0.027)	(0.028)	(0.032)	(0.028)	(0.026)
Agricultural jobs	-0.333***	-0.266***	-0.242***	-0.217***	-0.224***	-0.208***	-0.219***	-0.205***	-0.196***	-0.198***
	(0.014)	(0.017)	(0.017)	(0.016)	(0.015)	(0.014)	(0.014)	(0.017)	(0.014)	(0.012)
Dependency rate	-0.416***	-0.406***	-0.411***	-0.351***	-0.393***	-0.422***	-0.250***	-0.414***	-0.417***	-0.353***
	(0.021)	(0.026)	(0.026)	(0.025)	(0.026)	(0.025)	(0.027)	(0.029)	(0.026)	(0.025)
Head edu: primary	0.046***	0.053***	0.075***	0.081***	0.118***	0.130***	0.121***	0.103***	0.092***	0.109***
	(0.012)	(0.014)	(0.016)	(0.016)	(0.016)	(0.016)	(0.015)	(0.017)	(0.016)	(0.017)
Head edu: lower second	0.053***	0.088***	0.101***	0.129***	0.195***	0.185***	0.181***	0.162***	0.164***	0.167***
	(0.012)	(0.014)	(0.015)	(0.016)	(0.016)	(0.016)	(0.015)	(0.016)	(0.016)	(0.017)
Head edu: upper second	0.002	0.026	0.079***	0.067**	0.168***	0.174***	0.174***	0.168***	0.226***	0.206***
	(0.022)	(0.025)	(0.025)	(0.027)	(0.024)	(0.025)	(0.025)	(0.029)	(0.025)	(0.024)
Head edu: tertiary	0.053**	0.128***	0.171***	0.160***	0.245***	0.333***	0.337***	0.325***	0.286***	0.286***
	(0.026)	(0.040)	(0.039)	(0.026)	(0.036)	(0.040)	(0.036)	(0.041)	(0.032)	(0.034)
Any tertiary education	0.133***	0.144***	0.074**	0.053	0.040	0.151***	0.214***	0.091***	0.054**	-0.040
	(0.022)	(0.037)	(0.033)	(0.036)	(0.031)	(0.020)	(0.016)	(0.020)	(0.027)	(0.032)
Ratio: completed upper secondary	0.568***	0.632***	0.613***	0.526***	0.442***	0.485***	0.420***	0.380***	0.120***	0.182***
	(0.048)	(0.047)	(0.044)	(0.040)	(0.038)	(0.053)	(0.055)	(0.063)	(0.037)	(0.034)
Ratio: completed tertiary education	0.717***	0.535***	0.731***	0.769***	0.714***	0.269***	0.593***	0.384***	0.327***	0.633***
	(0.055)	(0.096)	(0.089)	(0.087)	(0.081)	(0.084)	(0.076)	(0.082)	(0.070)	(0.074)
Constant	8.511***	8.441***	8.454***	8.492***	8.781***	8.837***	8.757***	8.977***	9.029***	9.012***
	(0.024)	(0.027)	(0.028)	(0.030)	(0.028)	(0.026)	(0.027)	(0.030)	(0.027)	(0.027)
Observations	26726	8506	8632	8654	9063	8607	8843	8923	8654	9046
Adjusted R^2	0.363	0.413	0.414	0.402	0.425	0.391	0.406	0.390	0.383	0.379

(B) With regional variables:

	(1) lny2002	(2) lny2004	(3) lny2006	(4) lny2008	(5) lny2010	(6) lny2012	(7) lny2014	(8) lny2016	(9) lny2018	(10) lny2020
Minority	-0.155***	-0.189***	-0.184***	-0.222***	-0.319***	-0.323***	-0.345***	-0.321***	-0.310***	-0.323***
	(0.013)	(0.016)	(0.016)	(0.015)	(0.016)	(0.017)	(0.017)	(0.017)	(0.016)	(0.016)
Rural	-0.211***	-0.240***	-0.221***	-0.172***	-0.184***	-0.177***	-0.157***	-0.172***	-0.136***	-0.132***
	(0.013)	(0.016)	(0.016)	(0.015)	(0.015)	(0.014)	(0.014)	(0.015)	(0.014)	(0.012)
Ratio of employed	0.062***	0.136***	0.107***	0.093***	0.065**	0.085***	0.206***	0.125***	0.100***	0.177***
	(0.022)	(0.027)	(0.027)	(0.026)	(0.027)	(0.027)	(0.027)	(0.030)	(0.027)	(0.025)
Agricultural jobs	-0.203***	-0.159***	-0.147***	-0.127***	-0.161***	-0.154***	-0.177***	-0.139***	-0.138***	-0.138***
	(0.013)	(0.017)	(0.016)	(0.016)	(0.015)	(0.014)	(0.014)	(0.016)	(0.014)	(0.012)
Dependency rate	-0.337***	-0.334***	-0.364***	-0.305***	-0.360***	-0.396***	-0.226***	-0.372***	-0.393***	-0.330***
	(0.020)	(0.025)	(0.025)	(0.024)	(0.025)	(0.025)	(0.027)	(0.028)	(0.025)	(0.024)
Head edu: primary	0.068***	0.086***	0.098***	0.109***	0.125***	0.136***	0.125***	0.102***	0.084***	0.097***
	(0.011)	(0.014)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.016)	(0.016)	(0.016)
Head edu: lower second	0.123***	0.175***	0.181***	0.200***	0.220***	0.206***	0.200***	0.176***	0.166***	0.155***
	(0.012)	(0.014)	(0.015)	(0.015)	(0.016)	(0.016)	(0.015)	(0.016)	(0.016)	(0.017)
Head edu: upper second	0.066***	0.103***	0.142***	0.122***	0.193***	0.201***	0.195***	0.191***	0.234***	0.205***
	(0.021)	(0.024)	(0.024)	(0.026)	(0.023)	(0.025)	(0.025)	(0.029)	(0.025)	(0.024)
Head edu: tertiary	0.129***	0.204***	0.241***	0.261***	0.273***	0.353***	0.349***	0.341***	0.283***	0.290***
	(0.025)	(0.037)	(0.037)	(0.024)	(0.035)	(0.040)	(0.036)	(0.039)	(0.031)	(0.033)
Any tertiary education	0.108***	0.135***	0.055*	0.052	0.044	0.156***	0.220***	0.080***	0.046*	-0.028
	(0.020)	(0.034)	(0.033)	(0.035)	(0.031)	(0.020)	(0.016)	(0.019)	(0.026)	(0.031)
Ratio: completed upper secondary	0.554***	0.676***	0.638***	0.542***	0.452***	0.474***	0.397***	0.375***	0.097***	0.149***
	(0.047)	(0.044)	(0.042)	(0.038)	(0.038)	(0.053)	(0.055)	(0.063)	(0.036)	(0.033)
Ratio: completed tertiary education	0.764***	0.577***	0.754***	0.746***	0.705***	0.262***	0.600***	0.410***	0.335***	0.574***
	(0.053)	(0.090)	(0.088)	(0.082)	(0.080)	(0.085)	(0.077)	(0.078)	(0.068)	(0.074)
Average Agr revenue	0.059***	0.074***	0.037***	0.027***	0.008***	0.004***	0.006***	0.006***	0.000	0.002
	(0.005)	(0.005)	(0.003)	(0.003)	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
ln(Prov. Ind. output)	-0.010*	0.008	-0.004	-0.004	-0.006	-0.005	-0.000	-0.006**	0.000	0.000
	(0.005)	(0.006)	(0.006)	(0.005)	(0.004)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)
ln(Provincial GDP)	0.247***	0.169***	0.214***	0.206***	0.145***	0.153***	0.142***	0.230***	0.197***	0.235***
	(0.015)	(0.019)	(0.018)	(0.019)	(0.015)	(0.014)	(0.013)	(0.016)	(0.014)	(0.014)
Constant	6.697***	6.830***	6.768***	6.850***	7.687***	7.698***	7.622***	7.240***	7.500***	7.187***
	(0.071)	(0.093)	(0.094)	(0.100)	(0.087)	(0.085)	(0.088)	(0.107)	(0.099)	(0.101)
Observations	26726	8506	8632	8654	9063	8607	8843	8923	8654	9046
Adjusted R^2	0.415	0.467	0.464	0.452	0.444	0.412	0.423	0.420	0.407	0.410

Appendix Table 2: RIF regression for expenditure per capita: $\alpha = 0.5$

(A) Without regional variables:

	(1) RIF2002_5	(2) RIF2004_5	(3) RIF2006_5	(4) RIF2008_5	(5) RIF2010_5	(6) RIF2012_5	(7) RIF2014_5	(8) RIF2016_5	(9) RIF2018_5	(10) RIF2020_5
Minority	-0.044***	-0.058***	-0.055***	-0.059***	-0.071***	-0.071***	-0.077***	-0.073***	-0.069***	-0.075***
	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Rural	-0.035***	-0.041***	-0.038***	-0.034***	-0.032***	-0.032***	-0.028***	-0.032***	-0.026***	-0.025***
	(0.002)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Ratio of employed	0.004	0.016***	0.016***	0.011**	0.008*	0.010**	0.030***	0.016***	0.017***	0.031***
	(0.004)	(0.005)	(0.005)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)	(0.004)
Agricultural jobs	-0.048***	-0.040***	-0.038***	-0.033***	-0.034***	-0.032***	-0.035***	-0.033***	-0.031***	-0.033***
	(0.002)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)
Dependency rate	-0.070***	-0.070***	-0.071***	-0.061***	-0.068***	-0.071***	-0.044***	-0.068***	-0.069***	-0.057***
	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.004)	(0.004)
Head edu: primary	0.008***	0.010***	0.014***	0.016***	0.022***	0.023***	0.022***	0.019***	0.018***	0.022***
	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Head edu: lower second	0.009***	0.016***	0.019***	0.023***	0.035***	0.033***	0.032***	0.030***	0.029***	0.031***
	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Head edu: upper second	0.002	0.007*	0.015***	0.013***	0.030***	0.031***	0.032***	0.029***	0.037***	0.037***
	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.004)	(0.004)
Head edu: tertiary	0.012***	0.020***	0.028***	0.029***	0.041***	0.052***	0.055***	0.052***	0.047***	0.048***
	(0.004)	(0.005)	(0.005)	(0.004)	(0.005)	(0.005)	(0.005)	(0.006)	(0.005)	(0.005)
Any tertiary education	0.017***	0.026***	0.018***	0.015***	0.013***	0.026***	0.033***	0.015***	0.013***	-0.001
	(0.003)	(0.005)	(0.004)	(0.005)	(0.005)	(0.003)	(0.002)	(0.003)	(0.004)	(0.005)
Ratio: completed upper secondary	0.083***	0.093***	0.089***	0.077***	0.067***	0.072***	0.062***	0.061***	0.021***	0.030***
	(0.007)	(0.007)	(0.006)	(0.006)	(0.006)	(0.008)	(0.008)	(0.009)	(0.006)	(0.005)
Ratio: completed tertiary education	0.095***	0.052***	0.076***	0.080***	0.078***	0.025**	0.076***	0.044***	0.037***	0.081***
	(0.007)	(0.012)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.012)	(0.010)	(0.011)
Constant	1.396***	1.389***	1.392***	1.401***	1.448***	1.460***	1.447***	1.481***	1.491***	1.486***
	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.004)	(0.005)	(0.005)	(0.005)	(0.004)
Observations	26726	8506	8632	8654	9063	8607	8843	8923	8654	9046
Adjusted R^2	0.344	0.390	0.388	0.384	0.410	0.383	0.399	0.386	0.385	0.380

(B) With regional variables:

	(1) RIF2002_5	(2) RIF2004_5	(3) RIF2006_5	(4) RIF2008_5	(5) RIF2010_5	(6) RIF2012_5	(7) RIF2014_5	(8) RIF2016_5	(9) RIF2018_5	(10) RIF2020_5
Minority	-0.033***	-0.041***	-0.039***	-0.046***	-0.065***	-0.065***	-0.069***	-0.064***	-0.061***	-0.066***
	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Rural	-0.031***	-0.036***	-0.033***	-0.027***	-0.028***	-0.028***	-0.025***	-0.027***	-0.022***	-0.020***
	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Ratio of employed	0.012***	0.024***	0.019***	0.016***	0.011***	0.012***	0.034***	0.021***	0.019***	0.032***
	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.004)	(0.004)
Agricultural jobs	-0.029***	-0.024***	-0.023***	-0.019***	-0.024***	-0.023***	-0.027***	-0.022***	-0.022***	-0.024***
	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)
Dependency rate	-0.058***	-0.059***	-0.063***	-0.054***	-0.062***	-0.066***	-0.039***	-0.061***	-0.065***	-0.053***
	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.004)	(0.004)
Head edu: primary	0.012***	0.016***	0.018***	0.020***	0.023***	0.025***	0.023***	0.019***	0.017***	0.020***
	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Head edu: lower second	0.021***	0.031***	0.033***	0.035***	0.039***	0.037***	0.036***	0.033***	0.030***	0.029***
	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Head edu: upper second	0.012***	0.020***	0.026***	0.022***	0.034***	0.035***	0.036***	0.033***	0.039***	0.037***
	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.004)	(0.004)
Head edu: tertiary	0.024***	0.033***	0.040***	0.045***	0.045***	0.056***	0.058***	0.055***	0.047***	0.048***
	(0.003)	(0.005)	(0.005)	(0.004)	(0.005)	(0.006)	(0.005)	(0.006)	(0.005)	(0.005)
Any tertiary education	0.013***	0.024***	0.015***	0.015***	0.014***	0.027***	0.035***	0.014***	0.012***	0.001
	(0.003)	(0.005)	(0.004)	(0.005)	(0.005)	(0.003)	(0.002)	(0.003)	(0.004)	(0.005)
Ratio: completed upper secondary	0.082***	0.101***	0.095***	0.080***	0.069***	0.072***	0.059***	0.061***	0.018***	0.025***
	(0.006)	(0.007)	(0.006)	(0.006)	(0.006)	(0.008)	(0.008)	(0.009)	(0.006)	(0.005)
Ratio: completed tertiary education	0.103***	0.061***	0.081***	0.078***	0.077***	0.025**	0.078***	0.049***	0.038***	0.072***
	(0.007)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.010)	(0.011)
Average Agr revenue	0.011***	0.013***	0.007***	0.005***	0.002***	0.001***	0.001***	0.001***	0.000	0.000
	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(Prov. Ind. output)	-0.003***	0.000	-0.002	-0.001	-0.001	-0.001	0.000	-0.001	0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)
ln(Provincial GDP)	0.038***	0.027***	0.034***	0.033***	0.022***	0.025***	0.023***	0.036***	0.031***	0.037***
	(0.002)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)
Constant	1.126***	1.141***	1.130***	1.143***	1.278***	1.270***	1.260***	1.203***	1.246***	1.189***
	(0.011)	(0.015)	(0.015)	(0.015)	(0.014)	(0.013)	(0.014)	(0.017)	(0.016)	(0.017)
Observations	26726	8506	8632	8654	9063	8607	8843	8923	8654	9046
Adjusted R^2	0.394	0.441	0.437	0.433	0.428	0.404	0.415	0.415	0.407	0.408

Appendix Table 3: RIF regression for expenditure per capita: $\alpha = 2$

Without regional variables:

	(1) RIF2002_20	(2) RIF2004_20	(3) RIF2006_20	(4) RIF2008_20	(5) RIF2010_20	(6) RIF2012_20	(7) RIF2014_20	(8) RIF2016_20	(9) RIF2018_20
Minority	-0.053***	-0.075***	-0.068***	-0.077***	-0.098***	-0.097***	-0.109***	-0.100***	-0.095***
	(0.003)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Rural	-0.022***	-0.027***	-0.025***	-0.026***	-0.023***	-0.025***	-0.021***	-0.023***	-0.020***
	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Ratio of employed	0.010***	0.020***	0.019***	0.011**	0.012**	0.006	0.029***	0.017***	0.022***
	(0.003)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)	(0.005)
Agricultural jobs	-0.031***	-0.028***	-0.028***	-0.024***	-0.024***	-0.023***	-0.027***	-0.026***	-0.024***
	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)
Dependency rate	-0.063***	-0.070***	-0.068***	-0.064***	-0.067***	-0.065***	-0.048***	-0.063***	-0.062***
	(0.003)	(0.004)	(0.005)	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)	(0.004)
Head edu: primary	0.009***	0.014***	0.017***	0.020***	0.024***	0.027***	0.028***	0.024***	0.023***
	(0.002)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Head edu: lower second	0.010***	0.019***	0.024***	0.027***	0.036***	0.036***	0.037***	0.035***	0.033***
	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)
Head edu: upper second	0.006**	0.014***	0.020***	0.019***	0.034***	0.032***	0.037***	0.028***	0.035***
	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)
Head edu: tertiary	0.015***	0.021***	0.029***	0.032***	0.038***	0.041***	0.049***	0.045***	0.043***
	(0.003)	(0.004)	(0.004)	(0.003)	(0.004)	(0.004)	(0.005)	(0.006)	(0.005)
Any tertiary education	0.008***	0.024***	0.020***	0.019***	0.019***	0.022***	0.024***	0.012***	0.019***
	(0.002)	(0.003)	(0.003)	(0.003)	(0.004)	(0.002)	(0.002)	(0.003)	(0.004)
Ratio: completed upper secondary	0.054***	0.057***	0.055***	0.046***	0.039***	0.050***	0.043***	0.055***	0.021***
	(0.005)	(0.006)	(0.005)	(0.005)	(0.006)	(0.007)	(0.008)	(0.008)	(0.005)
Ratio: completed tertiary education	0.048***	-0.011	-0.000	0.002	0.008	-0.007	0.031***	0.008	-0.001
	(0.004)	(0.007)	(0.007)	(0.007)	(0.008)	(0.006)	(0.008)	(0.010)	(0.008)
Constant	1.339***	1.338***	1.342***	1.362***	1.402***	1.419***	1.408***	1.435***	1.448***
	(0.003)	(0.004)	(0.005)	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)
Observations	26726	8506	8632	8654	9063	8607	8843	8923	8654
Adjusted R^2	0.236	0.279	0.263	0.284	0.303	0.290	0.303	0.294	0.313

With regional variables:

	(1) RIF2002_20	(2) RIF2004_20	(3) RIF2006_20	(4) RIF2008_20	(5) RIF2010_20	(6) RIF2012_20	(7) RIF2014_20	(8) RIF2016_20	(9) RIF2018_20
Minority	-0.046***	-0.063***	-0.055***	-0.067***	-0.091***	-0.091***	-0.100***	-0.091***	-0.086***
	(0.003)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.006)	(0.005)	(0.005)
Rural	-0.019***	-0.023***	-0.022***	-0.020***	-0.020***	-0.021***	-0.019***	-0.019***	-0.017***
	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Ratio of employed	0.016***	0.026***	0.021***	0.016***	0.014***	0.008	0.033***	0.021***	0.023***
	(0.003)	(0.005)	(0.005)	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Agricultural jobs	-0.018***	-0.017***	-0.017***	-0.012***	-0.014***	-0.014***	-0.020***	-0.017***	-0.016***
	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)
Dependency rate	-0.054***	-0.060***	-0.061***	-0.056***	-0.062***	-0.060***	-0.043***	-0.056***	-0.057***
	(0.003)	(0.004)	(0.005)	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)	(0.004)
Head edu: primary	0.013***	0.020***	0.021***	0.024***	0.025***	0.029***	0.030***	0.024***	0.023***
	(0.002)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Head edu: lower second	0.021***	0.033***	0.038***	0.039***	0.040***	0.041***	0.042***	0.039***	0.034***
	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)
Head edu: upper second	0.015***	0.025***	0.030***	0.027***	0.038***	0.037***	0.041***	0.032***	0.037***
	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)
Head edu: tertiary	0.025***	0.032***	0.040***	0.047***	0.043***	0.045***	0.052***	0.048***	0.044***
	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.006)	(0.005)
Any tertiary education	0.006***	0.022***	0.017***	0.019***	0.019***	0.023***	0.025***	0.011***	0.018***
	(0.002)	(0.003)	(0.003)	(0.003)	(0.004)	(0.002)	(0.002)	(0.003)	(0.004)
Ratio: completed upper secondary	0.056***	0.067***	0.063***	0.050***	0.042***	0.053***	0.043***	0.058***	0.019***
	(0.005)	(0.006)	(0.005)	(0.005)	(0.006)	(0.007)	(0.008)	(0.008)	(0.005)
Ratio: completed tertiary education	0.056***	0.000	0.006	0.002	0.008	-0.003	0.035***	0.015	0.001
	(0.004)	(0.009)	(0.008)	(0.008)	(0.008)	(0.007)	(0.008)	(0.010)	(0.008)
Average Agr revenue	0.011***	0.013***	0.007***	0.005***	0.002***	0.002***	0.002***	0.002***	0.001**
	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(Prov. Ind. output)	-0.005***	-0.002*	-0.003**	-0.002**	0.001	-0.001	0.001	0.000	0.001*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)
ln(Provincial GDP)	0.030***	0.022***	0.027***	0.028***	0.013***	0.022***	0.017***	0.025***	0.023***
	(0.002)	(0.003)	(0.004)	(0.003)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)
Constant	1.143***	1.145***	1.137***	1.152***	1.275***	1.253***	1.246***	1.218***	1.244***
	(0.009)	(0.016)	(0.018)	(0.014)	(0.013)	(0.013)	(0.015)	(0.017)	(0.018)
Observations	26726	8506	8632	8654	9063	8607	8843	8923	8654
Adjusted R^2	0.273	0.316	0.299	0.318	0.314	0.306	0.314	0.310	0.326

Appendix Table 4: RIF regression for income per capita: $\alpha = 0$ (average change in the log outcome)

Without regional variables:

	(1) lny2002	(2) lny2004	(3) lny2006	(4) lny2008	(5) lny2010	(6) lny2012	(7) lny2014	(8) lny2016	(9) lny2018	(10) lny2020
Minority	-0.317***	-0.345***	-0.349***	-0.393***	-0.390***	-0.502***	-0.509***	-0.528***	-0.627***	-0.531***
	(0.014)	(0.018)	(0.018)	(0.008)	(0.008)	(0.019)	(0.019)	(0.009)	(0.021)	(0.019)
Rural	-0.240***	-0.273***	-0.250***	-0.251***	-0.201***	-0.195***	-0.179***	-0.187***	-0.156***	-0.103***
	(0.014)	(0.018)	(0.018)	(0.009)	(0.008)	(0.016)	(0.015)	(0.007)	(0.016)	(0.013)
Ratio of employed	0.170***	0.173***	0.246***	0.289***	0.353***	0.388***	0.404***	0.452***	0.423***	0.492***
	(0.026)	(0.033)	(0.032)	(0.015)	(0.015)	(0.033)	(0.034)	(0.015)	(0.032)	(0.028)
Agricultural jobs	-0.375***	-0.301***	-0.282***	-0.280***	-0.334***	-0.303***	-0.297***	-0.312***	-0.268***	-0.287***
	(0.015)	(0.018)	(0.018)	(0.008)	(0.007)	(0.017)	(0.015)	(0.007)	(0.015)	(0.013)
Dependency rate	-0.475***	-0.427***	-0.359***	-0.347***	-0.278***	-0.319***	-0.236***	-0.317***	-0.339***	-0.283***
	(0.024)	(0.031)	(0.029)	(0.014)	(0.014)	(0.031)	(0.034)	(0.014)	(0.030)	(0.026)
Head edu: primary	0.043***	0.062***	0.086***	0.098***	0.137***	0.121***	0.123***	0.143***	0.135***	0.109***
	(0.013)	(0.017)	(0.017)	(0.008)	(0.008)	(0.019)	(0.018)	(0.009)	(0.020)	(0.019)
Head edu: lower second	0.015	0.092***	0.115***	0.122***	0.199***	0.172***	0.219***	0.213***	0.201***	0.183***
	(0.013)	(0.017)	(0.017)	(0.008)	(0.008)	(0.019)	(0.018)	(0.009)	(0.020)	(0.018)
Head edu: upper second	-0.040	0.041	0.095***	0.091***	0.165***	0.149***	0.257***	0.209***	0.209***	0.145***
	(0.025)	(0.028)	(0.027)	(0.014)	(0.013)	(0.030)	(0.028)	(0.015)	(0.029)	(0.025)
Head edu: tertiary	-0.018	0.178***	0.143***	0.219***	0.206***	0.294***	0.407***	0.327***	0.342***	0.203***
	(0.026)	(0.044)	(0.041)	(0.013)	(0.018)	(0.039)	(0.036)	(0.017)	(0.034)	(0.033)
Any tertiary education	0.140***	0.137***	0.035	0.093***	0.091***	0.275***	0.060***	0.212***	0.027	-0.015
	(0.024)	(0.042)	(0.034)	(0.018)	(0.016)	(0.023)	(0.018)	(0.009)	(0.027)	(0.027)
Ratio: completed upper secondary	0.577***	0.657***	0.648***	0.577***	0.520***	0.520***	0.383***	0.441***	0.283***	0.346***
	(0.053)	(0.053)	(0.048)	(0.021)	(0.021)	(0.056)	(0.058)	(0.031)	(0.042)	(0.035)
Ratio: completed tertiary education	0.723***	0.565***	0.982***	0.924***	0.930***	0.361***	0.734***	0.443***	0.616***	0.855***
	(0.054)	(0.104)	(0.087)	(0.042)	(0.040)	(0.082)	(0.074)	(0.032)	(0.067)	(0.071)
Constant	6.081***	6.153***	6.142***	6.055***	6.132***	6.357***	6.387***	6.476***	6.675***	6.715***
	(0.028)	(0.031)	(0.031)	(0.015)	(0.014)	(0.032)	(0.033)	(0.014)	(0.032)	(0.027)
Observations	26751	8543	8677	43428	45322	8654	8777	44758	8974	9214
Adjusted R^2	0.316	0.377	0.398	0.393	0.408	0.396	0.411	0.439	0.457	0.429

With regional variables:

	(1) lny2002	(2) lny2004	(3) lny2006	(4) lny2008	(5) lny2010	(6) lny2012	(7) lny2014	(8) lny2016	(9) lny2018	(10) lny2020
Minority	-0.184***	-0.218***	-0.222***	-0.274***	-0.312***	-0.428***	-0.414***	-0.432***	-0.504***	-0.426***
	(0.014)	(0.018)	(0.018)	(0.008)	(0.008)	(0.019)	(0.019)	(0.009)	(0.020)	(0.018)
Rural	-0.213***	-0.232***	-0.218***	-0.200***	-0.164***	-0.164***	-0.160***	-0.147***	-0.120***	-0.062***
	(0.014)	(0.017)	(0.017)	(0.008)	(0.007)	(0.016)	(0.014)	(0.007)	(0.015)	(0.013)
Ratio of employed	0.238***	0.228***	0.266***	0.313***	0.370***	0.407***	0.444***	0.485***	0.443***	0.512***
	(0.024)	(0.031)	(0.030)	(0.014)	(0.014)	(0.032)	(0.033)	(0.014)	(0.031)	(0.027)
Agricultural jobs	-0.216***	-0.176***	-0.173***	-0.166***	-0.220***	-0.221***	-0.228***	-0.218***	-0.160***	-0.200***
	(0.015)	(0.018)	(0.018)	(0.008)	(0.007)	(0.017)	(0.015)	(0.007)	(0.015)	(0.013)
Dependency rate	-0.367***	-0.341***	-0.305***	-0.283***	-0.226***	-0.275***	-0.192***	-0.269***	-0.285***	-0.239***
	(0.023)	(0.029)	(0.028)	(0.013)	(0.013)	(0.030)	(0.033)	(0.013)	(0.029)	(0.025)
Head edu: primary	0.081***	0.102***	0.111***	0.127***	0.151***	0.136***	0.133***	0.143***	0.131***	0.107***
	(0.012)	(0.016)	(0.016)	(0.008)	(0.008)	(0.018)	(0.017)	(0.008)	(0.020)	(0.017)
Head edu: lower second	0.123***	0.198***	0.201***	0.211***	0.254***	0.217***	0.256***	0.238***	0.227***	0.194***
	(0.013)	(0.016)	(0.017)	(0.008)	(0.008)	(0.019)	(0.017)	(0.008)	(0.019)	(0.017)
Head edu: upper second	0.055**	0.133***	0.163***	0.155***	0.218***	0.195***	0.297***	0.231***	0.248***	0.165***
	(0.024)	(0.027)	(0.026)	(0.013)	(0.012)	(0.029)	(0.028)	(0.014)	(0.028)	(0.024)
Head edu: tertiary	0.091***	0.271***	0.221***	0.337***	0.265***	0.330***	0.432***	0.354***	0.359***	0.230***
	(0.024)	(0.041)	(0.039)	(0.013)	(0.018)	(0.039)	(0.036)	(0.016)	(0.033)	(0.032)
Any tertiary education	0.117***	0.128***	0.017	0.067***	0.095***	0.284***	0.074***	0.209***	0.023	0.002
	(0.023)	(0.039)	(0.033)	(0.017)	(0.016)	(0.021)	(0.018)	(0.009)	(0.026)	(0.026)
Ratio: completed upper secondary	0.577***	0.717***	0.670***	0.619***	0.552***	0.539***	0.353***	0.459***	0.265***	0.317***
	(0.048)	(0.050)	(0.046)	(0.020)	(0.020)	(0.057)	(0.058)	(0.031)	(0.039)	(0.033)
Ratio: completed tertiary education	0.817***	0.616***	1.002***	0.963***	0.958***	0.387***	0.749***	0.447***	0.622***	0.785***
	(0.052)	(0.099)	(0.084)	(0.041)	(0.040)	(0.083)	(0.077)	(0.033)	(0.066)	(0.070)
Average Agr revenue	0.115***	0.095***	0.041***	0.044***	0.025***	0.016***	0.015***	0.011***	0.012***	0.008***
	(0.006)	(0.006)	(0.003)	(0.002)	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)
ln(Prov. Ind. output)	0.041***	0.012	0.024***	0.024***	0.007**	0.021***	0.035***	0.035***	0.061***	0.049***
	(0.006)	(0.008)	(0.007)	(0.003)	(0.003)	(0.006)	(0.006)	(0.003)	(0.006)	(0.004)
ln(Provincial GDP)	0.150***	0.182***	0.170***	0.138***	0.139***	0.127***	0.109***	0.168***	0.111***	0.150***
	(0.016)	(0.021)	(0.019)	(0.010)	(0.009)	(0.019)	(0.017)	(0.009)	(0.019)	(0.017)
Constant	4.223***	4.316***	4.461***	4.502***	4.784***	5.039***	5.069***	4.717***	5.061***	4.987***
	(0.078)	(0.102)	(0.097)	(0.054)	(0.049)	(0.107)	(0.103)	(0.054)	(0.115)	(0.111)
Observations	26751	8543	8677	43428	45322	8654	8777	44758	8974	9214
Adjusted R^2	0.385	0.437	0.449	0.444	0.447	0.426	0.439	0.473	0.496	0.467

Appendix Table 5: RIF regression for income per capita: $\alpha = 0.5$

Without regional variables:

	(1) RIF2002_5	(2) RIF2004_5	(3) RIF2006_5	(4) RIF2008_5	(5) RIF2010_5	(6) RIF2012_5	(7) RIF2014_5	(8) RIF2016_5	(9) RIF2018_5	(10) RIF2020_5
Minority	-0.060***	-0.067***	-0.067***	-0.075***	-0.076***	-0.099***	-0.103***	-0.106***	-0.138***	-0.116***
	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)	(0.004)	(0.004)	(0.002)	(0.005)	(0.004)
Rural	-0.036***	-0.040***	-0.038***	-0.037***	-0.031***	-0.032***	-0.029***	-0.030***	-0.025***	-0.016***
	(0.002)	(0.003)	(0.003)	(0.001)	(0.001)	(0.003)	(0.002)	(0.001)	(0.003)	(0.002)
Ratio of employed	0.030***	0.030***	0.042***	0.046***	0.057***	0.060***	0.065***	0.071***	0.072***	0.078***
	(0.004)	(0.006)	(0.005)	(0.003)	(0.002)	(0.006)	(0.006)	(0.003)	(0.006)	(0.005)
Agricultural jobs	-0.053***	-0.046***	-0.044***	-0.045***	-0.053***	-0.048***	-0.048***	-0.052***	-0.045***	-0.050***
	(0.002)	(0.003)	(0.003)	(0.001)	(0.001)	(0.003)	(0.003)	(0.001)	(0.003)	(0.002)
Dependency rate	-0.079***	-0.077***	-0.064***	-0.063***	-0.050***	-0.058***	-0.042***	-0.055***	-0.061***	-0.050***
	(0.004)	(0.005)	(0.005)	(0.002)	(0.002)	(0.005)	(0.006)	(0.002)	(0.005)	(0.005)
Head edu: primary	0.008***	0.011***	0.016***	0.018***	0.025***	0.021***	0.022***	0.027***	0.031***	0.021***
	(0.002)	(0.003)	(0.003)	(0.001)	(0.001)	(0.003)	(0.003)	(0.002)	(0.005)	(0.004)
Head edu: lower second	0.003*	0.016***	0.021***	0.023***	0.035***	0.031***	0.039***	0.039***	0.042***	0.036***
	(0.002)	(0.003)	(0.003)	(0.001)	(0.001)	(0.003)	(0.003)	(0.002)	(0.004)	(0.003)
Head edu: upper second	-0.003	0.008*	0.017***	0.017***	0.029***	0.025***	0.045***	0.037***	0.040***	0.028***
	(0.004)	(0.004)	(0.004)	(0.002)	(0.002)	(0.005)	(0.005)	(0.003)	(0.005)	(0.005)
Head edu: tertiary	0.004	0.026***	0.025***	0.038***	0.036***	0.046***	0.066***	0.053***	0.060***	0.037***
	(0.004)	(0.006)	(0.005)	(0.002)	(0.003)	(0.005)	(0.005)	(0.003)	(0.006)	(0.005)
Any tertiary education	0.018***	0.027***	0.016***	0.024***	0.024***	0.045***	0.010***	0.036***	0.017***	0.012***
	(0.003)	(0.006)	(0.005)	(0.002)	(0.002)	(0.003)	(0.003)	(0.001)	(0.004)	(0.004)
Ratio: completed upper secondary	0.081***	0.097***	0.094***	0.083***	0.078***	0.082***	0.060***	0.069***	0.047***	0.058***
	(0.007)	(0.008)	(0.007)	(0.003)	(0.003)	(0.009)	(0.009)	(0.005)	(0.007)	(0.006)
Ratio: completed tertiary education	0.098***	0.052***	0.099***	0.088***	0.093***	0.026**	0.094***	0.045***	0.058***	0.093***
	(0.007)	(0.013)	(0.011)	(0.006)	(0.005)	(0.010)	(0.011)	(0.005)	(0.010)	(0.010)
Constant	0.985***	1.005***	1.005***	0.990***	1.004***	1.046***	1.051***	1.064***	1.092***	1.106***
	(0.004)	(0.005)	(0.005)	(0.002)	(0.002)	(0.005)	(0.006)	(0.002)	(0.006)	(0.005)
Observations	26751	8543	8677	43428	45322	8654	8777	44758	8974	9214
Adjusted R^2	0.319	0.353	0.378	0.365	0.384	0.382	0.398	0.424	0.438	0.414

With regional variables:

	(1) RIF2002_5	(2) RIF2004_5	(3) RIF2006_5	(4) RIF2008_5	(5) RIF2010_5	(6) RIF2012_5	(7) RIF2014_5	(8) RIF2016_5	(9) RIF2018_5	(10) RIF2020_5
Minority	-0.042***	-0.048***	-0.047***	-0.057***	-0.064***	-0.087***	-0.086***	-0.089***	-0.115***	-0.096***
	(0.002)	(0.004)	(0.003)	(0.002)	(0.002)	(0.004)	(0.004)	(0.002)	(0.005)	(0.004)
Rural	-0.032***	-0.034***	-0.033***	-0.029***	-0.025***	-0.027***	-0.026***	-0.023***	-0.019***	-0.009***
	(0.002)	(0.003)	(0.003)	(0.001)	(0.001)	(0.003)	(0.002)	(0.001)	(0.003)	(0.002)
Ratio of employed	0.040***	0.039***	0.045***	0.050***	0.059***	0.063***	0.072***	0.076***	0.075***	0.082***
	(0.004)	(0.005)	(0.005)	(0.002)	(0.002)	(0.005)	(0.006)	(0.003)	(0.006)	(0.005)
Agricultural jobs	-0.031***	-0.027***	-0.027***	-0.027***	-0.036***	-0.035***	-0.037***	-0.035***	-0.026***	-0.034***
	(0.002)	(0.003)	(0.003)	(0.001)	(0.001)	(0.003)	(0.002)	(0.001)	(0.003)	(0.002)
Dependency rate	-0.063***	-0.063***	-0.055***	-0.053***	-0.042***	-0.050***	-0.034***	-0.047***	-0.051***	-0.042***
	(0.003)	(0.005)	(0.005)	(0.002)	(0.002)	(0.005)	(0.006)	(0.002)	(0.005)	(0.004)
Head edu: primary	0.014***	0.018***	0.020***	0.023***	0.027***	0.023***	0.024***	0.027***	0.031***	0.021***
	(0.002)	(0.003)	(0.003)	(0.001)	(0.001)	(0.003)	(0.003)	(0.002)	(0.004)	(0.004)
Head edu: lower second	0.021***	0.033***	0.035***	0.037***	0.044***	0.038***	0.046***	0.044***	0.047***	0.039***
	(0.002)	(0.003)	(0.003)	(0.001)	(0.001)	(0.003)	(0.003)	(0.002)	(0.004)	(0.003)
Head edu: upper second	0.012***	0.023***	0.029***	0.028***	0.038***	0.033***	0.052***	0.041***	0.048***	0.033***
	(0.003)	(0.004)	(0.004)	(0.002)	(0.002)	(0.005)	(0.005)	(0.002)	(0.005)	(0.004)
Head edu: tertiary	0.021***	0.041***	0.038***	0.056***	0.045***	0.052***	0.071***	0.058***	0.064***	0.043***
	(0.003)	(0.006)	(0.005)	(0.002)	(0.003)	(0.005)	(0.006)	(0.003)	(0.006)	(0.005)
Any tertiary education	0.015***	0.025***	0.013***	0.020***	0.025***	0.047***	0.012***	0.036***	0.016***	0.015***
	(0.003)	(0.005)	(0.004)	(0.002)	(0.002)	(0.003)	(0.003)	(0.001)	(0.004)	(0.004)
Ratio: completed upper secondary	0.084***	0.108***	0.099***	0.090***	0.083***	0.085***	0.055***	0.074***	0.045***	0.054***
	(0.007)	(0.007)	(0.007)	(0.003)	(0.003)	(0.009)	(0.009)	(0.005)	(0.007)	(0.005)
Ratio: completed tertiary education	0.113***	0.062***	0.103***	0.094***	0.098***	0.029***	0.097***	0.047***	0.060***	0.081***
	(0.007)	(0.013)	(0.011)	(0.006)	(0.005)	(0.011)	(0.012)	(0.005)	(0.010)	(0.011)
Average Agr revenue	0.020***	0.016***	0.007***	0.007***	0.004***	0.003***	0.003***	0.002***	0.003***	0.002***
	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(Prov. Ind. output)	0.004***	0.000	0.003**	0.003***	0.001	0.004***	0.007***	0.007***	0.012***	0.010***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
ln(Provincial GDP)	0.021***	0.029***	0.028***	0.023***	0.021***	0.020***	0.015***	0.025***	0.015***	0.024***
	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.004)	(0.003)
Constant	0.728***	0.722***	0.738***	0.745***	0.802***	0.833***	0.838***	0.780***	0.828***	0.802***
	(0.011)	(0.016)	(0.015)	(0.009)	(0.008)	(0.017)	(0.017)	(0.009)	(0.021)	(0.020)
Observations	26751	8543	8677	43428	45322	8654	8777	44758	8974	9214
Adjusted R^2	0.382	0.408	0.427	0.411	0.418	0.410	0.426	0.457	0.473	0.452

Appendix Table 6: RIF regression for income per capita: $\alpha = 2$

Without regional variables:

	(1) RIF2002_20	(2) RIF2004_20	(3) RIF2006_20	(4) RIF2008_20	(5) RIF2010_20	(6) RIF2012_20	(7) RIF2014_20	(8) RIF2016_20	(9) RIF2018_20
Minority	-0.071***	-0.084***	-0.083***	-0.087***	-0.092***	-0.122***	-0.140***	-0.137***	-0.229***
	(0.003)	(0.005)	(0.005)	(0.002)	(0.002)	(0.006)	(0.007)	(0.003)	(0.024)
Rural	-0.026***	-0.025***	-0.025***	-0.022***	-0.022***	-0.025***	-0.024***	-0.022***	-0.019***
	(0.002)	(0.003)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.003)
Ratio of employed	0.029***	0.033***	0.040***	0.034***	0.046***	0.040***	0.052***	0.047***	0.079***
	(0.004)	(0.006)	(0.006)	(0.003)	(0.003)	(0.007)	(0.008)	(0.004)	(0.021)
Agricultural jobs	-0.033***	-0.033***	-0.033***	-0.034***	-0.040***	-0.035***	-0.038***	-0.040***	-0.036***
	(0.002)	(0.003)	(0.003)	(0.001)	(0.001)	(0.003)	(0.003)	(0.001)	(0.005)
Dependency rate	-0.072***	-0.080***	-0.065***	-0.067***	-0.054***	-0.061***	-0.045***	-0.054***	-0.071***
	(0.004)	(0.006)	(0.005)	(0.003)	(0.003)	(0.006)	(0.008)	(0.003)	(0.015)
Head edu: primary	0.007***	0.014***	0.017***	0.019***	0.025***	0.019***	0.021***	0.031***	0.070***
	(0.002)	(0.004)	(0.004)	(0.002)	(0.002)	(0.004)	(0.005)	(0.003)	(0.020)
Head edu: lower second	0.005**	0.015***	0.022***	0.026***	0.034***	0.029***	0.038***	0.039***	0.071***
	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)	(0.004)	(0.004)	(0.002)	(0.018)
Head edu: upper second	0.003	0.011**	0.020***	0.022***	0.029***	0.022***	0.040***	0.034***	0.063***
	(0.004)	(0.005)	(0.004)	(0.002)	(0.002)	(0.005)	(0.005)	(0.003)	(0.019)
Head edu: tertiary	0.014***	0.022***	0.028***	0.036***	0.034***	0.033***	0.051***	0.043***	0.083***
	(0.003)	(0.005)	(0.004)	(0.002)	(0.002)	(0.005)	(0.006)	(0.003)	(0.021)
Any tertiary education	0.008***	0.026***	0.020***	0.027***	0.027***	0.034***	0.009***	0.028***	0.026***
	(0.002)	(0.004)	(0.003)	(0.002)	(0.002)	(0.003)	(0.003)	(0.001)	(0.009)
Ratio: completed upper secondary	0.048***	0.061***	0.054***	0.048***	0.047***	0.060***	0.042***	0.050***	0.028**
	(0.006)	(0.007)	(0.006)	(0.003)	(0.003)	(0.008)	(0.009)	(0.006)	(0.011)
Ratio: completed tertiary education	0.044***	-0.019**	-0.002	-0.007	-0.001	-0.023***	0.034***	-0.001	-0.038**
	(0.005)	(0.009)	(0.007)	(0.004)	(0.004)	(0.007)	(0.010)	(0.004)	(0.018)
Constant	0.924***	0.946***	0.953***	0.938***	0.954***	1.002***	1.009***	1.015***	1.002***
	(0.003)	(0.005)	(0.005)	(0.003)	(0.003)	(0.006)	(0.007)	(0.003)	(0.019)
Observations	26751	8543	8677	43428	45322	8654	8777	44758	8974
Adjusted R^2	0.204	0.225	0.252	0.227	0.243	0.271	0.289	0.277	0.137

With regional variables:

	(1) RIF2002_20	(2) RIF2004_20	(3) RIF2006_20	(4) RIF2008_20	(5) RIF2010_20	(6) RIF2012_20	(7) RIF2014_20	(8) RIF2016_20	(9) RIF2018_20
Minority	-0.059***	-0.071***	-0.066***	-0.074***	-0.084***	-0.111***	-0.121***	-0.120***	-0.198***
	(0.004)	(0.005)	(0.005)	(0.002)	(0.002)	(0.006)	(0.007)	(0.003)	(0.020)
Rural	-0.023***	-0.021***	-0.022***	-0.016***	-0.018***	-0.021***	-0.022***	-0.017***	-0.013***
	(0.002)	(0.003)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.003)
Ratio of employed	0.037***	0.041***	0.042***	0.037***	0.048***	0.043***	0.058***	0.053***	0.084***
	(0.004)	(0.006)	(0.006)	(0.003)	(0.003)	(0.006)	(0.008)	(0.003)	(0.021)
Agricultural jobs	-0.019***	-0.020***	-0.020***	-0.021***	-0.028***	-0.024***	-0.026***	-0.024***	-0.013***
	(0.002)	(0.003)	(0.003)	(0.001)	(0.001)	(0.003)	(0.003)	(0.001)	(0.004)
Dependency rate	-0.061***	-0.069***	-0.057***	-0.059***	-0.048***	-0.055***	-0.036***	-0.045***	-0.056***
	(0.004)	(0.006)	(0.005)	(0.003)	(0.003)	(0.006)	(0.007)	(0.003)	(0.014)
Head edu: primary	0.012***	0.019***	0.021***	0.023***	0.027***	0.021***	0.024***	0.032***	0.072***
	(0.002)	(0.003)	(0.004)	(0.002)	(0.002)	(0.004)	(0.005)	(0.003)	(0.020)
Head edu: lower second	0.020***	0.031***	0.037***	0.037***	0.042***	0.035***	0.047***	0.046***	0.081***
	(0.002)	(0.004)	(0.003)	(0.002)	(0.002)	(0.004)	(0.004)	(0.002)	(0.019)
Head edu: upper second	0.016***	0.023***	0.031***	0.030***	0.036***	0.029***	0.048***	0.038***	0.076***
	(0.004)	(0.005)	(0.004)	(0.002)	(0.002)	(0.005)	(0.005)	(0.003)	(0.020)
Head edu: tertiary	0.027***	0.035***	0.039***	0.050***	0.041***	0.038***	0.057***	0.048***	0.091***
	(0.003)	(0.005)	(0.004)	(0.002)	(0.002)	(0.005)	(0.006)	(0.003)	(0.022)
Any tertiary education	0.006***	0.024***	0.018***	0.023***	0.027***	0.035***	0.011***	0.028***	0.026***
	(0.002)	(0.004)	(0.003)	(0.002)	(0.002)	(0.003)	(0.003)	(0.001)	(0.009)
Ratio: completed upper secondary	0.053***	0.073***	0.061***	0.053***	0.052***	0.061***	0.041***	0.060***	0.029**
	(0.006)	(0.007)	(0.006)	(0.003)	(0.003)	(0.008)	(0.009)	(0.006)	(0.011)
Ratio: completed tertiary education	0.058***	-0.007	0.004	-0.001	0.005	-0.021***	0.039***	0.006	-0.034*
	(0.005)	(0.010)	(0.008)	(0.005)	(0.005)	(0.008)	(0.011)	(0.005)	(0.019)
Average Agr revenue	0.019***	0.015***	0.008***	0.006***	0.003***	0.002***	0.004***	0.003***	0.005***
	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
ln(Prov. Ind. output)	0.000	-0.003*	0.000	0.002**	-0.000	0.005***	0.009***	0.008***	0.019***
	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.006)
ln(Provincial GDP)	0.013***	0.024***	0.024***	0.018***	0.013***	0.012***	0.005	0.011***	-0.004
	(0.003)	(0.004)	(0.003)	(0.002)	(0.002)	(0.003)	(0.004)	(0.002)	(0.013)
Constant	0.758***	0.733***	0.732***	0.748***	0.822***	0.840***	0.848***	0.813***	0.791***
	(0.011)	(0.017)	(0.015)	(0.009)	(0.009)	(0.016)	(0.019)	(0.011)	(0.041)
Observations	26751	8543	8677	43428	45322	8654	8777	44758	8974
Adjusted R^2	0.241	0.256	0.287	0.252	0.259	0.287	0.309	0.297	0.148