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Decomposing a Decomposition: Within-Country Differences and the Role of Structural Change in Productivity Growth

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Abstract

In this article, we investigate the relevance of structural change in country-wide productivity growth considering within-country differences. For this purpose, we propose a two-step decomposition approach that accounts for differences among subnational units. To highlight the relevance of our procedure compared to the prevalent approach in the existing development literature (which usually neglects subnational differences), we show an application with data for the Mexican economy. Specifically, we contrast findings obtained from country-sector data on the one hand with those obtained from (more disaggregated) state-sector data on the other hand. One main insight is that the qualitative and quantitative results differ substantially between the two approaches. Our procedure reveals that structural change appeared to be growth-reducing during the period from 2005 to 2016. We show that this negative effect is driven mainly by the reallocation of (low-skilled) labor within subnational units.

JEL Classification: L16, O10, O18, R11

Keywords: Decomposition approach, economic development, labor reallocation, regional differences, structural change

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1 Introduction

Structural change—the process of a reallocation of economic activities across sectors—appears to be very important to economic development. This is documented in various studies (e.g., Duarte and Restuccia, 2010; Herrendorf et al., 2014; Rodrik, 2016). Although this perception is not new (e.g., Lewis, 1954), it has been emphasized in numerous studies since 2010 (e.g., Busse et al., 2019; McMillan et al., 2014; Timmer et al., 2015). The rationale in this context is that countries may benefit from a factor reallocation toward more-productive sectors because this process contributes to aggregate productivity growth that, in turn, promotes economic development. Especially in the early stages of economic development, many countries tend to shift labor from less-productive agriculture to more-productive manufacturing or services sectors (Duarte and Restuccia, 2010). However, it turns out that different countries experience varying outcomes with respect to structural change over time (McMillan and Rodrik, 2011). To some extent, these different effects are likely to be associated with the current development status of each economy.

Because many countries are still lagging behind in economic development, in particular in terms of the sectoral structure, structural change is also a key topic beyond the economics research community. Structural change has been incorporated into the current (global) development policy agenda. Most notably, issues of structural change are included in the "Sustainable Development Goals" of the United Nations.[1] Related policy strategies are usually implemented by many (groups of) individuals from various countries. In each country coordinated decision-making with respect to structural change may involve different policy levels: national and subnational units. Thus, a detailed portrait of a country's national and subnational sectoral structure as well as a precise knowledge about the effects of structural change are needed as a basis for profound policy actions.

The aim of this article is to deepen the analysis of the role of structural change in productivity growth. More precisely, we point to the effects of structural change considering within-country differences. In this regard, we propose a two-step decomposition approach that accounts for differences among subnational units. To highlight the relevance of our procedure compared to the prevalent approach in the existing development literature, we show an application with

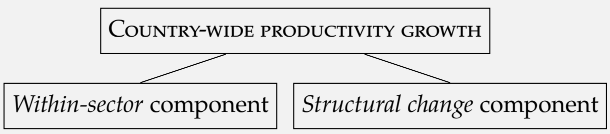
[1] For example, the role of structural change is implicitly addressed by Target 8.2, which is defined as "Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high value-added and labor-intensive sectors." More details are provided at https://sustainabledevelopment.un.org/.

data of the Mexican economy. We use disaggregated information at the country-sector and state-sector level to decompose productivity growth. Since we focus on labor productivity growth, we assess the role of structural change in terms of a reallocation of the factor *labor* across sectors and states.

The common procedure in the literature used to show the relevance of structural change in a country is to decompose country-wide productivity growth by sectors. Specifically, one can calculate the contributions of *within-sector* improvements (such as technological progress or an increase in the quality of institutions that promote the within-sector productivity) and *structural change* to country-wide productivity growth. This approach is depicted in Figure 1. Related empirical results offer interesting insights because the findings differ substantially across countries or country groups, respectively (e.g., Timmer et al., 2015). However, a main drawback of this procedure is that it neglects potential heterogeneity across subnational units. In fact, the approach is based on the assumption that key characteristics (such as the productivity level and the employment share) within each sector are homogeneous across a country. This involves potential inaccuracies in the calculation for countries that are characterized by significant differences among subnational units—in particular, with respect to the assessment of the structural change effect. The same sector that appears to be relatively unproductive in one location (i.e., a subnational unit) may be relatively productive in another location. Thus, a labor reallocation away from (or toward) that sector may have opposing effects in the structural change process in these two locations.

Figure 1: **Prevalent decomposition approach**

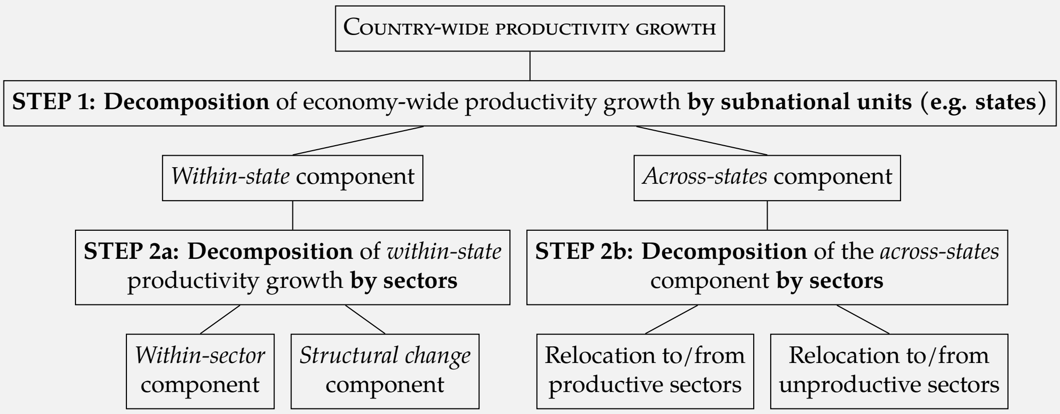
(Neglecting heterogeneity across subnational units)



Against this background, we propose an adjusted framework that is depicted in Figure 2. First (STEP 1), we decompose country-wide labor productivity growth by subnational units. In this regard, we incorporate an idea put forth by Felipe and Mehta (2016), who decompose productivity growth of the global economy ("world") by countries and regions. We adapt this approach for our purpose where one country is segmented by a certain level of subnational units. For our case of application (the Mexican economy), we consider a Mexican state to be the subnational unit. In principle, the framework may be used for other subnational levels as well. We decompose country-wide labor productivity growth into a *within-state* component and an *across-states* component. The former measures productivity changes within subnational units, and the latter indicates the effects of a labor relocation among these units.

Figure 2: **Adjusted decomposition approach**

(Considering heterogeneity across subnational units)



Second (STEP 2a), we decompose productivity growth within subnational units by sectors into a *within-sector* component and a *structural change* component. In principle, this step follows the same logic as the procedure in Figure 1. The differentiation reveals the importance of reallocating labor between economic activities within a subnational unit. As an extension, we integrate the role of skill levels in the structural change component.[2] In this regard, we differentiate among the reallocation of different types of labor: high-, medium-, and low-skilled. This is likely to be relevant in the context of structural change because each skill group may be differently affected by phenomena that are potentially associated with sectoral dynamics (e.g., the replacement of labor by automation or foreign competition).

Third (STEP 2b), we aim to disentangle the dynamics across states and divide this component into two effects. We classify two groups of sectors. One group comprises relatively productive sectors; the other covers relatively unproductive sectors. A change in the employment share over time in each of the two groups indicates either a labor relocation toward this

[2] This extension is not shown in the figure. Details are explained in Section 3.2.2.

group (positive change) or a relocation away from this sector group (negative change). Finally, both *across-states* effects can be interpreted as a part of country-wide structural change.

Our main results can be summarized as follows. In the descriptive part of the paper, we show that labor productivity levels are heterogeneous across Mexican states (across economic activities). This fact suggests the application of a decomposition framework that explicitly considers the heterogeneity of subnational units in an investigation of structural change. One main insight from the analysis is that the qualitative and quantitative decomposition results obtained from country-sector data (neglecting subnational differences) on the one hand and state-sector data (considering subnational differences) on the other hand differ significantly. The former (referring to the prevalent approach) suggests that structural change contributed positively to economy-wide growth between 2005 and 2016, whereas the latter (referring to our adjusted approach) indicates that structural change was growth-reducing during the same time period. In this regard, the negative effect is driven mainly by the reallocation of low-skilled labor within states. Based on the adjusted approach and the related findings, we suggest that policy makers should critically include research that considers subnational differences when deciding on policy actions directed toward growth-enhancing structural change.

The remainder of the paper is structured as follows. In Section 2, we provide a general discussion on the importance of heterogeneity in terms of economic activities and subnational units. Moreover, we describe the data and show some facts on the sectoral structure in Mexico. Section 3 constitutes the main part of the paper. We show details with respect to decomposition exercises and the calculation of structural change. Further, we present related results for the Mexican economy. Finally, we present concluding remarks in Section 4.

2 Data structure and sectoral patterns in Mexico

In principle, we focus on *labor* productivity in this paper. We compute levels and growth rates of this indicator using value-added and employment data. In this section, we present some facts related to our case of application: Mexico. The main data source in this paper is the Instituto Nacional de Estadítica y Geografía (INEGI; `http://www.inegi.org.mx/`). However, we start with some general aspects where we discuss the basic data structure and two dimensions of heterogeneity that appear to be relevant in the context of structural change.

2.1 Data disaggregation and two types of heterogeneity

Our framework introduced in Figure 2 can be characterized as a "two-step decomposition" strategy. This procedure requires that disaggregated sectoral data are available for each subnational unit. While we conduct the two decomposition steps, we address two types of heterogeneity in an economy: heterogeneity among subnational units and sectors. Starting with the former type, we argue that it is highly relevant to explicitly account for differences among subnational units or geographical locations, respectively. At least two aspects motivate this statement. First, productivity levels are likely to vary substantially across subnational units of a country. This is partly due to the fact that some activities (for example, those in the mining sector) are geographically bounded. These activities are supposed to generate added value in particular locations (with labor from the same location). In a general sense, all formal activities are assumed to be attributed to a certain location while assessing economic production according to national accounting standards. Second, a considerable amount of structural change—in terms of a labor reallocation—is likely to occur within relatively small spatial units (i.e., local labor markets) since labor mobility decreases with geographical distance (Lewer and Van den Berg, 2008; Molloy et al., 2014). In this context, subnational units appear to be more appropriate than a country-level perspective. Although subnational units may not fully reflect local labor markets, they are geographically limited. From this point of view, it is plausible to differentiate between a reallocation *within* a subnational unit and a re(al)location *between* such units when assessing structural change effects. After all, the reason to account for subnational units follows the same logic of why other studies account for differences between countries and calculate the effects for each country separately. Finally, the level of subnational units has to be chosen carefully for the respective context. A general argument that guides the decision process in this direction is the requirement related to the subnational data, which should be gathered according to national accounting standards.

The second aspect of heterogeneity—sectoral differences—constitutes the fundamental basis for the process of structural change. This aspect is strongly associated with the development status of the observed economy. Developing countries such as Mexico have already experienced typical first steps of structural change. Most notably, they transformed from early stages of economic development with a high share of employment in the primary sector (which is typically low productive) to more advanced stages of development with higher shares of employment in industry and the services sectors (which are more productive). In the context of early development stages a broad three-sector disaggregation of the economy is quite appropriate, because within-sector activities appear to be relatively homogeneous and labor productivity differences are relatively low.[3] By contrast, in more-advanced stages of economic development the sectoral structure of an economy is more diversified—especially in industry and services. Such a diversification usually comes with substantial labor productivity differences among subsectors. Thus, structural change effects during more-advanced stages are not only driven by a labor reallocation across the broad sectors but also within the broad sectors, that is, among subsectors. Since our investigation period (2005–2016) for Mexico falls within the context of more-advanced stages, we prefer a relatively disaggregated sectoral structure. In particular, we use the two-digit level of the North American Industry Classification System (NAICS) that groups the economy into 20 sectors. As we show below, Mexico recently has been a relatively service-oriented economy, with a diversified structure within this broad sector.

Finally, the selection of an appropriate level of sectoral disaggregation turns out to be highly relevant. For example, in a comparison of a three-sector and a nine-sector decomposition approach Üngör (2017) shows that the effects of structural change in Latin American countries differ significantly.

2.2 Economy-wide portrait based on country-sector data

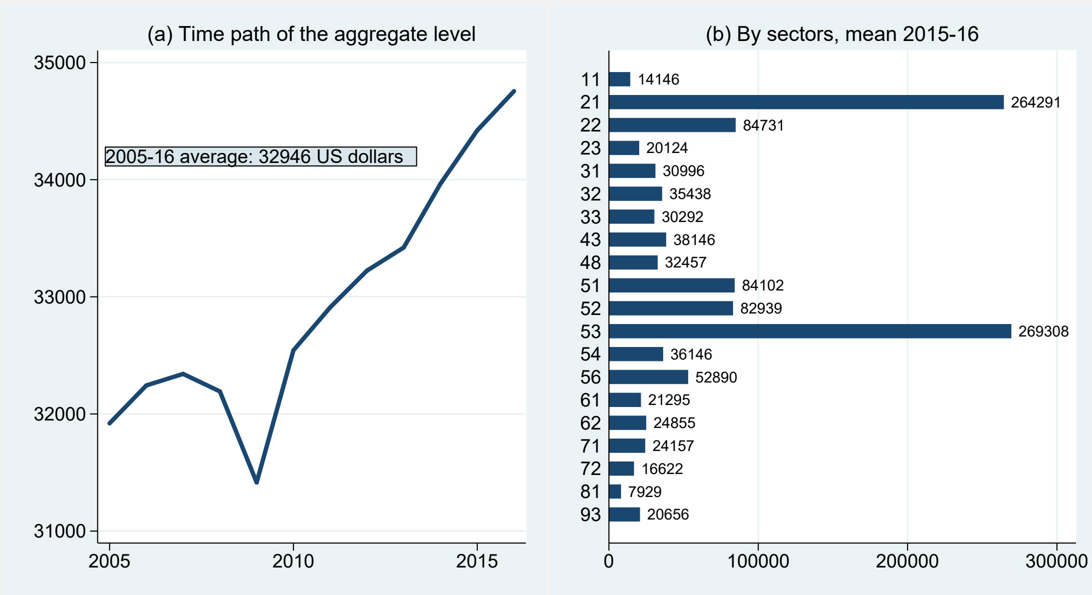
We define the country-wide labor productivity level of the Mexican economy (Y) as gross value-added (VA) per total employment (EMP). It reflects the aggregated value-added over all sectors of the economy divided by the total number of labor units (employees). Alternatively, it can also be expressed as the sum over sectoral labor productivity levels (LP) weighted by the sectoral employment share in total employment (Θ) as formulated in Equation (1), where the index t indicates the time period and j refers to the sectors. In total, there are k sectors in the economy; in our case $k = 20$.

[3] A basic definition of the term *structural transformation* is based on such a disaggregation with three sectors. Herrendorf et al. (2014, p.855) define it as "the reallocation of economic activity across the broad sectors agriculture, manufacturing, and services."

$$Y_t = \frac{VA_t}{EMP_t} = \sum_{j=1}^{k} \Theta_{j,t} \times LP_{j,t} \quad (1)$$

Figure 3(a) depicts the evolution of Y (given in constant values) over the years 2005–2016.[4] The level increases over the full time period, although there is a short slowdown and a reduction during the years of the financial crisis. The average productivity level in the time frame is 32,946 US dollars per employee. This country-wide average deviates from the levels of individual sectors (Figure 3(b)); in some cases the deviation is enormous. Extreme examples are the sector of "other services" (81) at the bottom end and "real estate, rental, and leasing services" (53) at the upper end. In the former case, LP relative to Y is roughly one-quarter, and in the latter case the average worker in sector 53 is more than eight times as productive as the average worker in the country.

Figure 3: **Country-wide labor productivity and its heterogeneity across sectors in Mexico**



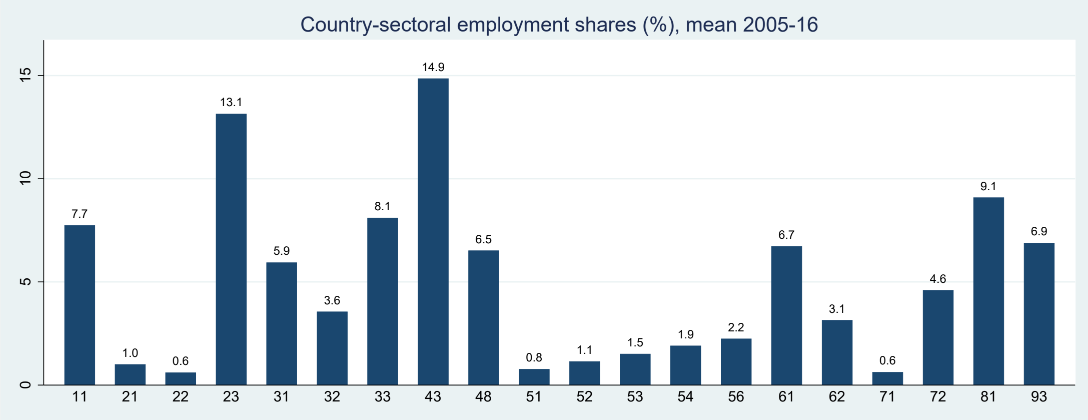
Data source: INEGI
Notes: All values are given in constant US dollars with 2013 as the base year. A definition of the sector codes 11-93 is provided in Appendix A.2.

Next, we briefly characterize the structure of the sectoral employment share. Taking into account Figure 4, we note that the group of services sectors (43–93) as an aggregate is dominant in Mexico where employment amounts to more than 60 percent on average. Individually,

[4] In Appendix A.1 we explain details of the data preparation and the specific data sources.

"wholesale and retail trade" activities (43) stand out with a share of 14.9 percent. Manufacturing (31–33) makes up almost 18 percent, and the predominant individual two-digit sector in industry is "construction" (13 percent). Finally, agriculture (11) employs almost eight percent of the total workforce.

Figure 4: **Differences in employment across sectors**



Data source: INEGI
Note: A definition of the sector codes 11-93 is provided in Appendix A.2.

2.3 Subnational perspective based on state-sector data

We change to a subnational perspective where the economic unit of observation is a Mexican state. We use this form of subnational unit because Mexico is officially divided into 32 federative entities (31 states and the capital, Mexico City) and the data computation is comparable to national accounting standards.[5]

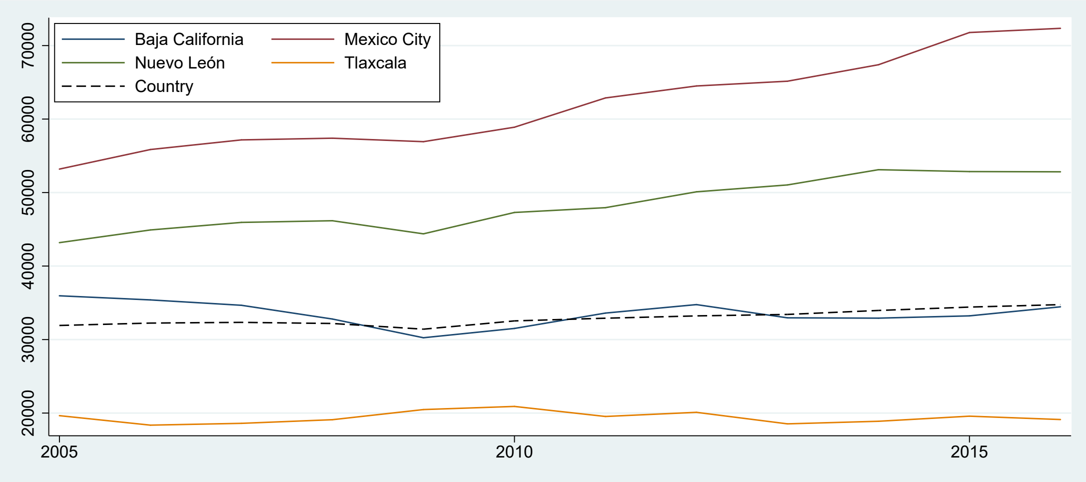
Using disaggregated value-added and employment data decomposed by states and sectors enables us to account for the two dimensions of heterogeneity previously described. We define the state-level labor productivity (y) in Equation (2). This expression is analog to the country-wide productivity definition. However, the notation for state-related variables is given in lowercase letters and additionally indexed with s. Thus, $\theta_{j,s,t}$ and $lp_{j,s,t}$ refer to the employment share and the labor productivity in sector j in state s and time t.

[5] Because the level of autonomy is similar for all federative entities, we consider 32 Mexican "states". Each state is free and sovereign and has its own congress and constitution (SCJN, 2010). In Appendix A.1 we explain details of the data preparation at the state-sector level.

$$y_{s,t} = \sum_{j=1}^{k} \theta_{j,s,t} \times lp_{j,s,t} \tag{2}$$

In Figure 5, we show the picture of y over time for a group of selected states to illustrate one main point of this section.[6] The graphs document the existing state heterogeneity in labor productivity levels. Moreover, they demonstrate some differences in the time paths. In Mexico City and Nuevo León the levels are clearly higher than the aggregated country level (dashed line); in the state of Mexico City it is roughly two times as high, and in Nuevo León it is about 1.5 times as high. The time paths in these two states are similar as productivity increases in the observation period. By contrast, the levels of Baja California and Tlaxcala are relatively constant and significantly lower. In Baja California productivity fluctuates around the reference level of the country, whereas in Tlaxcala the average employee is only two-thirds as productive as the average employee in the country.

Figure 5: **Evolution of state-wide labor productivity** $(y_{s,t})$



Data source: INEGI
Notes: All values are given in constant US dollars with 2013 as the base year.

Considering these substantial gaps in $y_{s,t}$ across states, it is not surprising that there are also differences among states in the productivity level of a given sector $(lp_{j,s,t})$. In Figure 6(a), we show this fact for four selected states. More specifically, we depict each state's sectoral productivity (lp) relative to the country-sector level (LP). Substantial differences among the states

[6] In Appendix B.1, we provide mean values of y for all states.

are visible in every sector. For example, regarding the average employee in sector 43 ("wholesale and retail trade"), in Tlaxcala she is less than half as productive compared to her average country counterpart, whereas in Mexico City she is almost twice as productive as her average country counterpart.

Additionally, we present a glance at the differences in the sectoral employment shares (θ) in Figure 6(b). Overall, differences among individual states appear to be stronger in agriculture and industry sectors than in services. For example, there are large gaps between Baja California and Tlaxcala with respect to manufacturing (31 and 33), whereas differentials are much lower in services sectors between those two states. A concentration of particular activities in individual states is clearly visible. Baja California and Nuevo León are relatively specialized in manufacturing of metallic and electronic products, machinery, and furniture (33), and Tlaxcala is relatively active in the manufacturing of food, beverages, tobacco, and textiles (31). Compared to all other states, Mexico City is relatively specialized in services with an aggregate share of over 70 percent.

Figure 6: **Sectoral productivity and employment for selected Mexican states, 2005–2016**

Data source: INEGI
Notes: A definition of the sector codes 11-93 is provided in Appendix A.2.

Finally, we provide a more comprehensive picture of labor productivity gaps among subnational units taking into account the sectoral structure. We conduct a shift-share analysis that illustrates the within-country differences. In principle, we follow Esteban-Marquillas (1972) and decompose the labor productivity gap between each state and the country's average into three components.[7] The formal expression is given in Equation (3).

$$y_{s,t} - Y_t = \underbrace{\sum_{j=1}^{k}(lp_{j,s,t} - LP_{j,t})\Theta_{j,t}}_{productivity\ differential} + \underbrace{\sum_{j=1}^{k}(\theta_{j,s,t} - \Theta_{j,t})LP_{j,t}}_{structural\ component} + \underbrace{\sum_{j=1}^{k}(\theta_{j,s,t} - \Theta_{j,t})(lp_{j,s,t} - LP_{j,t})}_{allocative\ component} \quad (3)$$

The first component on the right-hand side (RHS) refers to the *differential* component. Aggregating sector-by-sector productivity gaps weighted by the average sectoral employment share, it measures aspects such as a state's technological advantage (or backwardness, respectively) within sectors. The second term refers to the so-called *structural* gap. It measures the difference between a state's sectoral employment share and the respective average country share weighted by the sectoral labor productivity of the country. It can be interpreted as the advantage or disadvantage of a state in the sectoral mix. A positive value implies that a state is relatively specialized in highly productive activities at time t. Third, the *allocative* component can be interpreted as an indicator for the efficiency of a state to allocate labor among the economic sectors. In other words, it measures a state's concentration in relatively productive activities.

We list the gaps for the year 2005 by state in Table 1. Nine out of 32 states show a positive productivity gap. The best-performing state is by far Campeche. This is due mainly to a very high labor productivity level in the mining sector in this state. This makes Campeche an "outlier," whereas the other states have more moderate deviations from the country average. However, a positive (negative) productivity gap does not necessarily imply that the respective state is an overperformer (underperformer) with respect to all three components. For example, although Durango and Tamaulipas have a negative gap, both show a positive value in the "structural" component, meaning that they are relatively specialized in more-productive sectors. To conclude, the overall table reveals substantial labor productivity differences across Mexican states with a heterogeneous picture in the three components based on sectoral disparities. These facts

[7] For further application examples of the shift-share analysis in regional science as well as for additional details of the framework see Esteban (2000) or Benito and Ezcurra (2005).

clearly motivate our approach of a two-step decomposition analysis previously described. In principle, the shift share analysis of productivity (level) gaps can be used as a diagnostic tool to evaluate the relevance of subnational differences for the given country context.

Table 1: **Decomposition of each state's labor productivity gap in 2005 (in US dollars)**

	(1)	(2)	(3)	(4)
		Decomposition of the gap		
	Productivity gap	**Differential**	**Structural**	**Allocative**
Aguascalientes	-1162	-691	-1707	1236
Baja California	4040	5409	-819	-549
Baja California Sur	7218	3110	3437	671
Campeche	289312	74405	5932	208976
Chiapas	-14193	-24.3	-7176	-6992
Chihuahua	-4691	7449	-2683	-9456
Coahuila	9721	5726	11426	-7431
Colima	-5802	-5378	2343	-2767
Durango	-3962	-671	2732	-6023
Guanajuato	-5585	-3487	-1421	-677
Guerrero	-13169	-10016	-5712	2559
Hidalgo	-10058	-6233	-2344	-1481
Jalisco	-2934	-1877	-2183	1126
México	-13297	-13755	-416	875
Mexico City	21278	12491	1997	6790
Michoacán	-11320	-3673	-5701	-1947
Morelos	-6688	-5835	-1551	698
Nayarit	-8280	-7166	-4958	3845
Nuevo León	11268	9676	2227	-635
Oaxaca	-14638	-10890	-5946	2199
Puebla	-10292	-5752	-1926	-2614
Querétaro	3439	2153	1573	-287
Quintana Roo	-1359	-5552	439	3754
San Luis Potosí	-5284	-4196	2779	-3868
Sinaloa	-5175	-6692	-1271	2789
Sonora	8380	8350	1034	-1004
Tabasco	27075	18147	21412	-12485
Tamaulipas	-902	-958	2690	-2634
Tlaxcala	-12271	-9188	-4415	1332
Veracruz	-5451	-2493	4006	-6964
Yucatán	-8932	-7811	-3127	2006
Zacatecas	-9361	2341	-3499	-8204

Notes: All values refer to the mean of the full period 2005–2016 in constant US dollars, base year 2013.
Data source: INEGI.

3 Assessing the role of structural change in productivity growth

In this section, we first conduct an analysis as described in Figure 1. This procedure is commonly used in the related literature. The aim of this exercise is to provide a reference result that we can contrast with the subsequent findings obtained from our adjusted framework. Moreover, the reference result can be compared to the outcome of some related studies.[8] After that, we give a detailed explanation of our proposed "two-step decomposition" illustrated in Figure 2.

[8] For example, Padilla-Pérez and Villarreal (2017, p. 59) show some comparable findings for Mexico.

3.1 Neglecting heterogeneity of subnational units

We use country data disaggregated by sectors and decompose annual productivity growth of the total country into two components. The formal expression of this approach is given in Equation (4). This framework and its application in the recent development literature are proposed by McMillan and Rodrik (2011). Since then it has been used in several studies exploring the role of structural change in country-wide productivity growth.[9]

$$\hat{Y}_t = \frac{\Delta Y_t}{Y_{t-1}} = \underbrace{\frac{1}{Y_{t-1}} \sum_{j=1}^{k} \Theta_{j,t-1} \Delta LP_{j,t}}_{within-sector\ component} + \underbrace{\frac{1}{Y_{t-1}} \sum_{j=1}^{k} LP_{j,t} \Delta \Theta_{j,t}}_{structural\ change\ (SC)} \tag{4}$$

$\hat{Y}_t$ is defined as the labor productivity growth rate from $t-1$ to t. Δ refers to changes from $t-1$ to t of any variable. As mentioned previously, our preferred sectoral disaggregation level refers to the two-digit codes of the NAICS and covers 20 sectors. The first term of the right-hand side of the equation is labeled the *within-sector component*. It refers to all improvements that occur within the respective sector, such as technological progress or increases in the quality of the institutional framework that facilitates economic activities within a sector. The second term indicates the process of *structural change*. Any labor reallocation away from a sector is indicated by a decrease in the employment share over time measured by negative values of $\Delta\Theta_{j,t}$. To the contrary, a positive difference between $\Theta_{j,t}$ and $\Theta_{j,t-1}$ suggests a labor reallocation toward a sector. Growth-enhancing structural change requires that, in sum, labor moves (on average) from less- to more-productive sectors.

In some related studies (e.g., Padilla-Pérez and Villarreal, 2017; Timmer et al., 2015) the *structural change* term (SC) is further decomposed into the so-called *static* and *dynamic* effects (Equation (5)). At this stage, we also show this extension to briefly discuss the additional insights obtained from the related results. Moreover, this exercise allows for a more comprehensive comparison with the related studies that also include decomposition results for Mexico.

$$SC_t = \underbrace{\frac{1}{Y_{t-1}} \sum_{j=1}^{k} LP_{j,t-1} \Delta \Theta_{j,t}}_{static\ effect} + \underbrace{\frac{1}{Y_{t-1}} \sum_{j=1}^{k} \Delta LP_{j,t} \Delta \Theta_{j,t}}_{dynamic\ effect} \tag{5}$$

[9] In addition to research articles such as Timmer et al. (2015) and Busse et al. (2019), the framework is also applied in a recent book that documents country case studies with respect to the role of structural change in economic growth (McMillan et al., 2017).

To begin with a critical aspect, the labeling in the literature appears to be confusing to some extent. Considering that structural change by definition is a dynamic phenomenon, the label *static effect* seems inappropriate (Diao et al., 2017). However, the more detailed decomposition reveals some interesting insights. In many studies it turns out that the *dynamic* term is predominantly negative (e.g., de Vries et al., 2015). This implies that, on average, a sectoral labor share reduction is associated with a within-sector labor productivity increase, and a labor reallocation toward a sector is related to a productivity decrease in that sector. [10]

Table 2: **Decomposition of Mexico's country-wide productivity growth (%)**

	(1)	(2)	(3)	(4)	(5)
		Main components		Structural change components	
Period	**Annual productivity growth**	**Within sector component**	**Structural change**	**Static effect**	**Dynamic effect**
2005-2016	.79	.71	.08	.18	-.10
2005-2010	.41	.47	-.06	-.03	-.03
2010-2016	1.10	.90	.20	.36	-.16

Notes: All numbers are given in percent and refer to average annual growth rates. Columns (2) and (3) are based on Equ. (4) and columns (4) and (5) are based on Equ. (5).

The results obtained from Equations (4) and (5) are depicted in Table 2. Annual productivity growth during the period 2005–2016 in Mexico amounts to 0.79 percent. This is due mainly to within-sector improvements, which contribute 0.71 percentage points. Total structural change makes up a relatively small fraction of ten percent (that is, 0.08 percentage points; column (3)). Moreover, the deeper investigation of structural change shows that the *static* effect is responsible for the positive contribution, and the *dynamic* term reduces the former effect, which is in line with findings described previously.

Additionally, we note that the effect of structural change is negative in the (sub-)period 2005-2010, whereas it is positive between 2010 and 2016. While comparing the two periods, it should be considered that the former sub-period covers the years of the global financial crisis when the overall performance was relatively low with 0.4 percent productivity growth. Finally,

[10] Finally, one should note that the *dynamic* term appears to be hard to interpret separately. For example, imagine a two-sector economy with sectors A and B. Sector A is (substantially) less productive than sector B. If productivity growth in sector A is positive while its employment share is falling in the same period, this contributes negatively to the *dynamic* term. Yet, on average, the movement of workers out of sector A to the more-productive sector B results in a positive contribution to structural change and economy-wide productivity growth (see McMillan et al., 2017, p. 10).

based on the findings of the entire observation period (2005-2016), we would conclude that structural change in Mexico is on average growth-enhancing—although the effect is relatively small compared to within-sector improvements.

3.2 Considering heterogeneity of subnational units

In the next step, we establish our approach of a more detailed decomposition analysis of an economy where we account for sectoral and subnational differences. We proceed as illustrated in Figure 2 and start with STEP 1.

3.2.1 Decomposition of productivity growth by subnational units

For the decomposition of country-wide productivity growth by states, we draw on an idea put forth by Felipe and Mehta (2016). They propose a framework that decomposes global productivity growth by countries. More specifically, they show the contribution of countries to "world" total growth and "world" growth in manufacturing, respectively. We adapt this approach for our purpose and formulate Equation (6).

$$\hat{Y}_t = \underbrace{\frac{1}{Y_{t-1}} \sum_{s=1}^{n} \overline{\lambda}_{s,t} \Delta y_{s,t}}_{within-\ state\ component} + \underbrace{\frac{1}{Y_{t-1}} \sum_{s=1}^{n} \overline{y}_{s,t} \Delta \lambda_{s,t}}_{across\ states\ component} \tag{6}$$

In principle, this expression is similar to the approach in Equation (4); however, the unit of disaggregation is a state (instead of a sector). The number of states is indicated by n. Additionally, we define $\lambda_{s,t}$ as the employment share of a state s in total Mexican employment at time t, and $\overline{\lambda}_{s,t}$ is the average employment share of periods $t-1$ and t. Moreover, $\overline{y}_{s,t}$ refers to the average labor productivity of periods $t-1$ and t.

The first term on the right-hand side, the *within-state* component, refers to an improvement or a deterioration of the performance within states. It is the sum over state-level productivity changes weighted by the average employment share of each state. We define the second term as the *across-states* component. It is calculated from the sum over state-level employment share changes weighted by the respective labor productivity level and can be interpreted as an interstate labor reallocation. The distinction between the two components reveals important insights because it allows for the identification of growth within subnational units while separating this from the effects of a potential labor re(al)location across subnational units in the economy.

The results are listed in Table 3, which is structured as follows. The first row "Country" depicts the findings calculated from Equation (6). The second part of the table shows each state's contribution to Mexico-wide productivity growth. That is, all values of each column (1 to 3) add up to the respective "Country" value in the first row. The understanding of a specific number is best explained with an example. The contribution of the state "Aguascalientes" to the country's across-states component is on average 0.011 percentage points between 2005 and 2016. This implies that (on average) there was a labor reallocation toward Aguascalientes.

Table 3: **Decomposition of productivity growth by state, 2005-2016**

	(1)	(2)	(3)
		Decomposition of growth	
	Annual productivity growth (in % points)	**Within states** (in % points)	**Across states** (in % points)
Country	.79	.9	-.11
Each state's contribution to country-wide growth			
Aguascalientes	.0363	.0252	.0111
Baja California	.00883	-.0134	.0223
Baja California Sur	.0174	-.0016	.019
Campeche	-.35	-.366	.0159
Chiapas	.00475	-.00556	.0103
Chihuahua	.0464	.034	.0124
Coahuila	.0273	.00497	.0223
Colima	.0122	.00701	.00517
Mexico City	.184	.48	-.297
Durango	.0121	-.00203	.0141
Guanajuato	.0895	.0444	.0451
Guerrero	.00555	.00302	.00253
Hidalgo	.0232	.0128	.0104
Jalisco	.0981	.115	-.0169
Michoacán	.0267	.0325	-.00578
Morelos	-.00516	-.0019	-.00325
México	.109	.115	-.00592
Nayarit	.00743	.0000236	.00741
Nuevo León	.11	.131	-.0212
Oaxaca	.00389	.00825	-.00436
Puebla	.0323	.0338	-.00154
Querétaro	.0567	.0544	.00237
Quintana Roo	.0399	.0249	.015
San Luis Potosí	.0318	.0328	-.00103
Sinaloa	.0257	.0332	-.00752
Sonora	.0538	.0267	.0271
Tabasco	.02	-.00986	.0299
Tamaulipas	-.0126	-.00743	-.00516
Tlaxcala	.00273	-.00151	.00424
Veracruz	.03	.0574	-.0275
Yucatán	.0195	.017	.00254
Zacatecas	.0199	.016	.00388

Notes: All values refer to the mean of the full period 2005-2016.
Data source: INEGI.

The most important aspects of Table 3 are the following. First, Mexico-wide annual productivity growth of 0.79 percent stems from improvements within the states (0.9 percentage points). By contrast, the labor re(al)location across states reduced productivity growth by 0.11 percentage points. In other words, labor moved on average to less-productive states. Second, a closer look at the state-specific numbers reveals that the latter effect is driven mainly by labor movements away from Mexico City. The country's capital has a relatively high labor productivity, which is clearly above the average level. Thus, movements away from this state reduces overall productivity growth because labor is on average less productive in all other states (except for Campeche).[11]

3.2.2 Structural change and within-state growth

We continue with STEP 2a of our approach and assess the relevance of structural change in each state. For the computation, we apply the same approach as in Expression (4) but we use state-sector-level data (of value-added and employment). We define $\hat{y}_{s,t}$ as the labor productivity growth rate of state s in period t.

$$\hat{y}_{s,t} = \underbrace{\frac{1}{y_{s,t-1}} \sum_{j=1}^{k} \theta_{j,s,t-1} \Delta lp_{j,s,t}}_{within-\ sector\ component} + \underbrace{\frac{1}{y_{s,t-1}} \sum_{j=1}^{k} lp_{j,s,t} \Delta \theta_{j,s,t}}_{structural\ change\ component} \tag{7}$$

In Table 4 we present the results obtained from Equation (7) in columns (1) to (3). The values refer to means of the period 2005-2016. In the last row, we show the (unweighted) average across all states of the respective indicators. On average, the states grew moderately at an annual rate of 0.75 percentage points. The positive development is exclusively due to within-sector improvements (contributing 2.68 percentage points). Structural change appears to be growth-reducing. This effect is substantial with a magnitude of -1.93 percentage points. In terms of quality, these findings also apply for all individual states except for Campeche. That is, within-sector changes are growth-enhancing, and structural change turns out to be growth-reducing. In other words, within Mexican states the reallocation of labor was (on average) directed toward less-productive sectors between 2005 and 2016.

In order to investigate the role of the structural change component in more detail, we follow Escobar and Mühlen (2018) and conduct a further decomposition of this term with respect to skill levels—instead of separating it into *static* and *dynamic* effects, which is usually done in the

[11] It should be noted that employment in Mexico City also decreased in absolute terms during the considered time period.

Table 4: **Decomposition of state-level productivity growth by sectors, 2005-2016**

	(1)	(2)	(3)	(4)	(5)	(6)
		Growth decomposition		Decomposition of structural change		
	Productivity growth	**Within sectors**	**Structural change**	**High-skilled reallocation**	**Medium-skilled reallocation**	**Low-skilled reallocation**
Aguascalientes	2.3	2.8	-.48	.11	.82	-1.4
Baja California	-.29	1.1	-1.4	-.17	-.32	-.91
Baja California Sur	.0024	2.2	-2.2	-.84	-.51	-.83
Campeche	-6.4	-7.2	.81	1.6	-.49	-.34
Chiapas	-.29	10	-11	-.34	-.74	-9.7
Chihuahua	1.2	4.8	-3.5	-.49	-.65	-2.4
Coahuila	.36	1.8	-1.5	-.78	.8	-1.5
Colima	1.3	2.2	-.89	.085	-.056	-.92
Durango	-.13	1.9	-2	-.056	-.25	-1.7
Guanajuato	1.2	2	-.76	.23	.76	-1.8
Guerrero	.24	2.4	-2.2	-.58	.13	-1.7
Hidalgo	.93	5.1	-4.2	-.33	-1.5	-2.3
Jalisco	1.8	2.8	-1	.18	.38	-1.6
Michoacán	1.5	2.8	-1.4	-.36	.25	-1.2
Morelos	-.041	2.2	-2.2	-.85	-.2	-1.2
México	1.4	2.4	-1	-.019	.04	-1.1
Mexico City	2.9	3.4	-.51	-.14	.078	-.45
Nayarit	.075	.95	-.88	.22	.12	-1.2
Nuevo León	1.9	2.6	-.7	-.23	.52	-.99
Oaxaca	.56	3.8	-3.3	-.13	-1.4	-1.7
Puebla	1.1	3.6	-2.5	-.22	-.62	-1.7
Querétaro	2.7	4.2	-1.5	.25	-.065	-1.7
Quintana Roo	1.8	2.4	-.62	.14	.37	-1.1
San Luis Potosí	1.7	4.1	-2.4	-.73	-.014	-1.6
Sinaloa	1.6	2.9	-1.3	.54	.079	-1.9
Sonora	.92	1.9	-1	.39	.18	-1.6
Tabasco	-.26	1.5	-1.7	.041	.092	-1.9
Tamaulipas	-.23	2.9	-3.2	-.53	-1.3	-1.3
Tlaxcala	-.13	1.3	-1.4	.62	-.45	-1.6
Veracruz	1.2	5	-3.8	-1.5	-.59	-1.8
Yucatán	1.2	1.4	-.19	.57	.48	-1.2
Zacatecas	1.9	4	-2	-.057	.61	-2.6
(Unweighted) average	.75	2.68	-1.93	-.1	-.11	-1.72

Notes: All values refer to the mean of the full period 2005-2016.
Data source: INEGI.

literature (see Equation (5)). Distinguishing among skill groups is relevant in the context of structural change because different types of labor are supposed to be characterized by different reallocation dynamics across sectors. For example, low-skilled labor (performing routine activities) is more likely to be replaced by machines and, thereby, reallocated to other activities than high-skilled labor (performing more flexible and innovative tasks). Autor and Dorn (2013) show evidence for the US where a reallocation of low-skilled labor toward service occupations is associated with automating routine tasks.

We decompose the state-level structural change term ($sc_{s,t}$) into three components that account for the skill level of employment (high-skilled, medium-skilled, and low-skilled). Formally, we can express this approach as follows in Equation (8).

$$sc_{s,t} = \frac{1}{y_{s,t-1}} \left(\underbrace{\sum_{j=1}^{k} lp_{j,s,t-1} \Delta\theta_{j,s,t}^{high}}_{high-skilled\ term} + \underbrace{\sum_{j=1}^{k} lp_{j,s,t-1} \Delta\theta_{j,s,t}^{medi}}_{medium-skilled\ term} + \underbrace{\sum_{j=1}^{k} lp_{j,s,t-1} \Delta\theta_{j,s,t}^{low}}_{low-skilled\ term} \right) \tag{8}$$

Based on differentiated employment data, we isolate each skill group's sectoral employment share ($\theta_{j,s,t}^{high}$, $\theta_{j,s,t}^{medi}$, and $\theta_{j,s,t}^{low}$) in a state. Then, we calculate each skill group's structural change effect where we weight each sectoral employment share change with the labor productivity in a sector.[12] The sum of all three components amounts to the total structural change effect in a state.

The related results are shown in columns (4) to (6) in Table 4. Most notably, considering the average effects across states in the last row, the negative impact of total structural change (-1.93) is driven mainly by a reallocation of low-skilled labor toward less-productive sectors (-1.72 percentage points). Structural change based on medium- and high-skilled labor reallocation is also negative, but the two components contribute only -0.1 percentage points each. Looking at the individual results, this dominance of the low-skilled labor reallocation effect can also be observed in almost all states, except for Baja California Sur and Campeche. In contrast to the average findings, the high- and medium-skilled labor reallocation effects turn out to be positive in ten states (such as Aguascalientes or Sonora). This reveals that there are differences in the effects of each skill group in some states and, consequently, the picture is quite heterogeneous across the country. Moreover, it documents some positive structural change effects in parts of Mexico.

3.2.3 Across-states re(al)location

Although the *across-states* component (second term on the RHS in Equation (6)) appears to be less important for country-wide productivity growth in the given case, it is worth investigating the changes in the employment share in more detail. In this regard, we aim to reveal some further insights with respect to structural change. Our aim is to disentangle the dynamics in the state-level employment shares according to specific sector groups (STEP 2b). The approach is formally expressed in Equation (9).

[12] Note that we are not able to identify the labor productivity of each skill group at the sector level. Even at the firm-level it may be complicated to assess how productive different (groups of) employees are.

$$\hat{\lambda}_{s,t} = \frac{1}{\lambda_{s,t-1}} \sum_{j=1}^{k} \Delta\vartheta_{j,s,t} = \frac{1}{\lambda_{s,t-1}} \left(\underbrace{\sum_{j=1}^{m} \Delta\vartheta_{j,s,t}}_{productive\ sectors} + \underbrace{\sum_{j=m+1}^{k-m} \Delta\vartheta_{j,s,t}}_{unproductive\ sectors} \right) \tag{9}$$

$\vartheta_{j,s,t}$ is defined as sectoral employment in state s divided by total (country-wide) employment. Thus, a change in that variable indicates an increase or decrease of a sector relative to aggregate employment. The sum over all k sectoral changes in $\vartheta_{j,s,t}$ is equal to the change in the employment share of a state.

Table 5: **Fragmentation of state-level employment share growth, 2005-2016**

	(1)	(2)	(3)
		Fragmentation of lambda growth	
	Lambda growth (in % points)	**Productive** (in % points)	**Unproductive** (in % points)
Aguascalientes	1.01	.899	.106
Baja California	.747	1.05	-.304
Baja California Sur	2.68	1.5	1.17
Campeche	.284	.311	-.0269
Chiapas	.619	.974	-.355
Chihuahua	.512	2.03	-1.52
Coahuila	.647	.538	.109
Colima	.952	1.09	-.136
Durango	1.25	2.54	-1.28
Guanajuato	1.25	1.73	-.477
Guerrero	.184	.483	-.299
Hidalgo	.766	2.03	-1.27
Jalisco	-.263	.626	-.889
México	-.0577	.115	-.172
Mexico City	-1.7	-.201	-1.49
Michoacán	-.208	.796	-1
Morelos	-.28	.415	-.695
Nayarit	1.17	1.69	-.519
Nuevo León	-.281	.506	-.786
Oaxaca	-.255	.141	-.396
Puebla	-.0245	.818	-.843
Querétaro	.146	1.08	-.929
Quintana Roo	1.17	.683	.488
San Luis Potosí	-.0479	.925	-.972
Sinaloa	-.308	.642	-.95
Sonora	.927	1.77	-.839
Tabasco	.95	1.58	-.629
Tamaulipas	-.134	1.19	-1.32
Tlaxcala	.745	1.15	-.409
Veracruz	-.521	.703	-1.22
Yucatán	.224	.717	-.493
Zacatecas	.412	.994	-.583
(Unweighted) average	.393	.985	-.592

Notes: All values refer to the mean of the full period 2005-2016.
Data source: INEGI.

Now, we classify two groups of sectors. The first group comprises "productive" sectors in a state. Sectors that show a labor productivity level above the country level in period t belong to this group (i.e., $\frac{lp_{j,s,t}}{LP_{j,t}} > 1$). The number of "productive" sectors (m) may vary across states (and across time). The second group consists of "unproductive" sectors that show labor productivity levels below the country level in period t (i.e., $\frac{lp_{j,s,t}}{LP_{j,t}} < 1$). Finally, we take the sum over the sectors in each group. We list the related results by state in Table 5.

On average (last row), the effect of "productive" sectors is positive, and the effect of "unproductive" sectors is negative. These findings also apply to individual states with only a few exceptions. This result is interesting because it implies that states are increasing in those activities that are relatively productive while they are decreasing in those sectors that are relatively unproductive. Thus, although labor is on average relocated toward less-productive states (indicated by the country-wide across-states effect in Table 3), there is a clear tendency that it moves toward relatively productive activities. Separately, this development indicates a positive effect as part of the sectoral dynamics in Mexico. Considering that relocation across subnational borders is likely to involve reallocation across sectors, these effects partly contribute to structural change.

3.2.4 Country-wide effects

Taking into account all individual results described previously, we calculate country-wide effects in a final step. Following Equation (6), we weight the within-state effects (from Section 3.2.2) with the respective average employment share of a state, and we multiply the individual across-states effects (from Section 3.2.3) with the average labor productivity of a state. The results are presented in Table 6 and refer to each component's contribution to annual labor productivity growth (given in percentage points).

Table 6: **Decomposition of country-wide productivity growth considering subnational and sectoral differences**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
		Within-states effects				*Across states effects*	
			Structural change				
Period	**Productivity growth**	**Within sectors**	**high-skill**	**medium-skill**	**low-skill**	**Productive sectors**	**Unproductive sectors**
2005-2016	.79	2.39	-.07	-.03	-1.39	.67	-.78
2005-2010	.41	1.8	-.02	-.08	-1.23	.59	-.67
2010-2016	1.1	2.88	-.11	.004	-1.52	.74	-.88

Notes: All values refer to the mean of the respective period.
Data source: INEGI.

Positive contributions to overall productivity growth are predominantly driven by within-sector improvements within states. For the full period 2005-2016, the annual effect amounts to 2.39 percentage points. Factors such as technological progress or advancements in production procedures are likely to play a role in this context. By contrast, structural change was clearly growth-reducing in the observed period. This negative effect is dominated by the reallocation of low-skilled labor (-1.39 percentage points), whereas the impact of the high- and medium-skilled components are only marginal.

As pointed out previously, the net across-states effect is negative and due mainly to a substantial labor relocation away from Mexico City. However, although labor is relocated toward (on average) less-productive states, the results in columns (2) and (3) of Table 5 suggest that almost all states are increasing in relatively productive activities and decreasing in relatively unproductive sectors. Comparing these findings with the country-wide effects in Table 6, we observe that the latter fact is less pronounced for relatively less-productive states. In other words, more advanced states are stronger decreasing in less-productive activities than less-productive states. This implies that less-productive states remain relatively backward in terms of the sectoral structure, and this harms the overall growth performance of the country.

Nevertheless, the relocation across states involves some dynamics that may—to some extent—affect overall structural change in the Mexican economy. This can be assumed because the relocation across states is likely to include some reallocation across sectoral borders. Quantitatively, the contribution to structural change is unclear because the decomposition does not allow for an identification of labor movements across sectoral borders as part of the inter-state dynamics. Yet, as the effects across states appear to be relatively small compared to the intra-state effects, we conclude that structural change was clearly growth-reducing in the Mexican economy between 2005 and 2016.

Finally, we can draw a comparison between the common approach and our adjusted framework by contrasting structural change results. Comparing Table 2 and Table 6, we find a clear contradicting outcome. On the one hand, the decomposition of country-wide growth by sectors suggests that structural change was growth-enhancing (though small in magnitude: 0.08 percentage points). This result is based on the procedure commonly used in the recent development literature. On the other hand, the adjusted decomposition (which also accounts for subnational differences) indicates that structural change reduced annual growth substantially. Within states this effect amounts to 1.49 percentage points on average. The differences in the findings illustrate that heterogeneity across subnational units matters in a decomposition exercise. Neglecting the fact of productivity differences among sectors and subnational units leads to inaccurate results. In this case, it leads to a completely different conclusion for Mexico based on opposing qualitative outcomes.

4 Concluding remarks

In this paper, we propose an approach that accounts for the heterogeneity of subnational units while decomposing productivity growth of countries. Such a framework is relevant for numerous economies because they are characterized by within-country differences in particular activities. In our application—the country case of Mexico—we observe a considerable heterogeneity among states' sectoral productivity levels. One main insight from the decomposition analysis is that the results obtained from country-sector data (neglecting subnational differences) on the one hand and state-sector data (considering subnational differences) on the other hand differ significantly—quantitatively and even qualitatively. In this regard, we consider our approach to be more accurate—in particular, with respect to structural change effects. We find that within-states structural change was clearly growth-reducing between 2005 and 2016. It reduced the annual country-wide productivity growth by 1.49 percentage points. This negative impact is driven mainly by a reallocation of low-skilled labor toward less-productive activities. Additionally, the relocation of employment across states diminished growth as well because labor moved on average toward less-productive states. However, this effect is small in size.

Based on our findings, we suggest that policy makers should critically include research that considers subnational differences when deciding on policy actions directed toward growth-enhancing structural change. In the given case, we point to two aspects while taking the perspective of a policy adviser for Mexico. First, country-wide productivity growth in the recent past (2005-2016) was driven mainly by growth *within states*, whereas a labor re(al)location *across states* played only a minor role. The latter result may also be associated with the fact that, in general, labor is relatively immobile across geographical locations. Taking these aspects into account, the potential for growth-enhancing structural change appears to be more likely within states, and, thus, policy actions should address state-level issues. In this regard, it may be useful to include policy makers at the state-level in decision processes. Second, within-state structural change was growth-reducing in almost all states, and this negative effect was associated with a reallocation of low-skilled labor in almost all states. This suggests that there is an overall problem that has to be addressed at the national level. Thus, it is likely that a coordinated interplay of national and subnational policies is required to aim at sustainable growth-enhancing structural change.

Although our two-step decomposition generates more-accurate results relative to many existing studies, there is need for further research. One aspect is that there is also heterogeneity within sectors. Preferably, we would consider firm heterogeneity because even among firms within the same sector there are productivity gaps. Thus, in the aggregate, labor reallocation from low-productive to high-productive firms within sectors can also generate productivity growth. Since the high-productive firms tend to be the most-innovative ones, such labor reallocation could also be interpreted as a kind of structural change—even though the reallocation was not across sectoral borders. Moreover, labor reallocation between two firms active in different sectors may contribute to structural change in the proper sense. Finally, firm-level panel data may also enable accounting for considerations such as firm exit and firm entry.

Another aspect for further research is related to a point we mentioned previously. Local labor markets are assumed to be more appropriate to serve as subnational units while investigating the reallocation of employment. However, the preparation of such an analysis is complicated because data based on national accounting standards is usually not available at this level.

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Appendix

A Definitions

A.1 Data preparation and sources

For each of Mexico's 32 states, our data cover 20 economic activities using the NAICS 2013 two-digit-level classification. These 20 economic activities cover the total economy and are defined in Appendix A.2. We use different databases from INEGI to compute employment (labor units) and labor productivity (measured as value-added per labor unit) at the state-sector level.

First, we obtain data of employment per economic activity at the country level. These data are drawn from INEGI's System of National Accounts of Mexico (SNAM). The number of labor units correspond to the number of paid employees; thus, owners and family workers are not included in this dataset. The advantage of these data is that they allow for a segmentation of labor into three skill groups according to a worker's education: (1) low-skilled (up to basic or primary education), (2) medium-skilled (from secondary education to high school), and (3) high-skilled (with a degree higher than high school). These data were retrieved from INEGI's Total Factor Productivity database, https://www.inegi.org.mx/temas/ptf/

Second, to estimate labor units at the state-sector level, we combine SNAM data with individual-level data from INEGI's National Survey on Employment (ENOE), http://www.beta.inegi.org.mx/programas/enoe/15ymas/. More precisely, for each year and two-digit sector, we estimate the share of labor units (excluding owners and family workers) of each state. We then use these shares and the number of workers from SNAM data to obtain the number of workers per state-sector pair. We follow the same process to calculate the labor units per skill group of each state-sector pair.

Finally, to estimate labor productivity we use data on value-added. We retrieve data on gross value-added (GVA) at the state-sector level in constant 2013 Mexican Pesos from INEGI's SNAM. The data source is INEGI's Banco de Información Económica, http://www.inegi.org.mx/sistemas/bie/. Note that we convert the data into US dollars to make the absolute numbers comparable to other studies.

A.2 Sectoral structure (NAICS)

Sector code	Description
AGR	**Agriculture**
11	Agriculture
IND	**Industry**
21	Mining & quarrying
22	Utilities: Electric, water, and gas supply
23	Construction
31	Manufacturing: Food, beverages, tobacco, textiles
32	Manufacturing: Wood, paper, chemicals, non-metallic products
33	Manufacturing: Metallic and electronic products, machinery, furniture
SER	**Services**
43	Wholesale and retail trade
48	Transportation
51	Information services
52	Finance and insurance services
53	Real estate, rental, and leasing services
54	Professional, scientific, and technical services
56	Business support services, waste management and remediation services
61	Educational services
62	Health care and social assistance
71	Arts, entertainment, and recreation
72	Accommodation and food services
81	Other services
93	Public administration

Notes: Sectors are classified according to the NAICS 2013 two-digit level. For details see https://www.inegi.org.mx/app/scian/.

B Descriptive statistics

B.1 Labor productivity levels and employment shares by state (means 2005-2016)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Aggregate indicators		Sectoral indicators*					
	$y_{s,t}$ (in 1,000 US$)	$\lambda_{s,t}$ (in %)	$lp_{j,s,t}$ (in 1,000 US$)			$\theta_{j,s,t}$ (in %)		
Selected sectors:			11	23	53	11	23	53
Aguascalientes	34	1	46	39	220	3.2	12	1.6
Baja California	34	3	31	36	200	3.2	12	2
Baja California Sur	39	.64	25	49	101	5.5	17	3.2
Campeche	223	.79	9.9	93	378	11	16	.93
Chiapas	18	3.3	5.1	12	569	26	13	.49
Chihuahua	30	3.3	38	22	505	4.8	11	.91
Coahuila	42	2.7	45	26	241	2.4	12	1.5
Colima	28	.67	22	28	170	6.9	14	2.3
Mexico City	62	9.1	14	32	302	.25	8.3	2.5
Durango	28	1.4	32	18	378	9.1	13	1
Guanajuato	27	4.4	18	17	235	6.4	14	1.4
Guerrero	18	2.6	6	13	254	17	13	1.1
Hidalgo	23	2.1	8.4	13	412	13	15	.97
Jalisco	32	6.8	34	20	264	5.3	13	1.6
Michoacán	22	3.5	19	9.5	322	13	14	1.1
Morelos	24	1.6	12	20	233	6.4	16	1.4
México	20	14	12	6.9	348	2.6	14	1.2
Nayarit	23	.96	14	23	256	13	13	1.5
Nuevo León	48	4.8	30	39	217	1.1	13	2.6
Oaxaca	18	2.9	4.9	16	501	21	13	.64
Puebla	23	4.7	6.6	12	426	15	13	.85
Querétaro	40	1.7	26	24	177	3.8	16	2.2
Quintana Roo	32	1.4	7.4	22	125	3.9	14	3.7
San Luis Potosí	29	2.2	9.4	19	381	11	12	1.1
Sinaloa	29	2.5	27	23	210	13	13	1.9
Sonora	41	2.5	42	29	208	6.2	13	1.8
Tabasco	61	1.8	9.7	32	278	9.5	13	1.5
Tamaulipas	31	3.3	30	26	324	3.6	13	1.2
Tlaxcala	19	.98	8.5	12	333	8.6	16	1
Veracruz	27	6	9.3	17	427	15	15	1
Yucatán	24	1.9	14	18	177	6.9	15	1.8
Zacatecas	27	1.1	15	16	563	14	16	.7

Notes: * For reasons of clarity, we present descriptive numbers with respect to three selected sectors, namely, 11, 23, and 53. A definition of the sector codes 11-93 is provided in Appendix A.2.

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