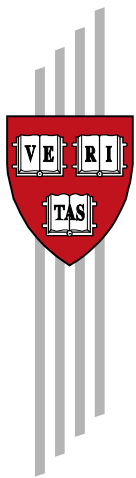# Place-specific Determinants of Income Gaps: New Sub-National Evidence from Chiapas, Mexico

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Place-specific Determinants of Income Gaps:
New Sub-National Evidence from Chiapas, Mexico

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Abstract

The literature on income gaps between Chiapas and the rest of Mexico revolves around individual factors, such as education and ethnicity. Yet, twenty years after the Zapatista rebellion, the schooling gap between Chiapas and the other Mexican entities has shrunk while the income gap has widened, and we find no evidence indicating that Chiapas indigenes are worse-off than their likes elsewhere in Mexico. We explore a different hypothesis. Based on census data, we calculate the economic complexity index, a measure of the knowledge agglomeration embedded in the economic activities at a municipal level in Mexico. Economic complexity explains a larger fraction of the income gap than any individual factor. Our results suggest that chiapanecos are not the problem, the problem is Chiapas. These results hold when we extend our analysis to Mexico's thirty-one federal entities, suggesting that place-specific determinants that have been overlooked in both the literature and policy, have a key role in the determination of income gaps.

I. Introduction

Chiapas is not only the poorest state in Mexico, but also the one growing the least. Challenging the predictions of the neoclassical theory of growth, instead of converging, Chiapas is diverging: The income gap relative to the rest of Mexico continues to widen. That reality is at odds with the vast resources that have been thrown in the region since the Zapatista uprising on January 1st, 1994, and the significant improvements in educational attainment and infrastructure that have taken place since. Why the income gap relative to the rest of Mexico continues to broaden? How can we account for such a paradox? Most of the efforts aimed at explaining the income gap in Chiapas have focused on individual or household factors, such as indigenous origins, education or asset endowment (De Janvry and Sadoulet, 2000; Lopez Arevalo and Nunez Medina, 2015; World Bank, 2005). Yet, when all these factors are considered, 60% of the income gap remains unexplained. We propose a different approach, considering place-specific characteristics that condition the choices and behaviors of individuals living in Chiapas.

This is in line with a modern strand of literature searching for place-specific explanations of development and income growth and gaps. These studies stress how cities and regions have complex economic development processes that are shaped by an infinite range of forces. In one of his path-breaking contributions, Michael Storper argues that *'explaining the growth and change of regions and cities is one of the great challenges for social science'* (Storper, 2011:333). Moreover, this growing interest has been followed by a recent surge of interest in advanced countries for corresponding policies, such as the smart specialization strategy of the European Union (McCann and Ortega-Argilés, 2015), and the various initiatives undertaken by several states in the United States of America (Neumark and Simpson, 2014). In particular, the smart specialization concept evolved as a response to the challenges associated with innovation policy design in the European

context, while allowing for the varied evolutionary nature of regional economies (McCann and Ortega-Argilés, 2015).

In this study, we address the issue of place-specific determinants of income growth and gaps using the concept of economic complexity, a measure of the know-how embedded in the economic activities at a municipal level in Mexico. Such place-specific economic complexity is able to explain a larger share of the income gap than any of many individual factors, like education, experience, indigenous origins, gender and living environment (rural vs. urban). Our results suggest that *chiapanecos* are not poor because they lack individual assets, but rather because there is not a modern ecosystem where they can deploy their assets in a productive manner. This approach in turn helps in explaining the large income differences observed across places within Chiapas itself.

As there is not a single Mexico, there is neither a single Chiapas. The large income gaps that exist across Mexican states are reproduced within Chiapas as in a fractal. Whereas Mexico's richest state (Distrito Federal) has an average income per capita six times that of its poorest state (Chiapas); Tuxtla Gutierrez, the capital of Chiapas, has an average income per capita that is eight times that of Aldama and Mitontic, its poorest municipalities. Nationwide factors such as the state of the economy or even potentially state-variant characteristics such as poor institutions, cannot explain the sizable income differences observed within municipalities in Chiapas. Individual factors might help explaining some of the income gap, but many relevant place-specific factors have remained overlooked in the literature. In each place, there exist different know-how, skills and productive capacities, that make an ecosystem where individuals can combine their assets in a more productive way that can sustain higher salaries. Without such ecosystem, no endowment of individual factors can overcome income poverty, as most productive and modern economic activities entail mixing different types of expertise and abilities.

From a development standpoint, Chiapas possesses an intrinsic interest that goes beyond its ethnic diversity and conflictive past. Since the uprising of the *Ejército Zapatista de Liberación Nacional* (EZLN) in 1994, Chiapas received a significant amount of policy attention and resources from the federal government. A vast array of social programs was launched, targeting the most vulnerable families in the state. Cash transfers, together with large investments in education and infrastructure, were the work horses of the federal effort to appease the region (Aguilar-Pinto et al., 2017, Van Leeuwen and Van der Haar, 2016). As a consequence, Chiapas registered significant improvements in its road network, and nowadays has a large – mostly idle – port (Puerto Chiapas), and three commercial airports (*Tuxtla Gutiérrez, Tapachula, and Palenque*). The schooling gap between Chiapas and the rest of Mexico has been closing from more than three years for the cohort born in 1965, to less than two years in more recent cohorts. And yet, the income gap continues to widen, suggesting that none of these was the most binding constraint.

We analyze the factors associated to poverty in Chiapas, and find that a significant fraction of the income per worker gap remains unexplained when we account only for individual factors such as quantity and quality of education, gender, or indigenous origins. In order to better understand relative poverty rates, it is essential that we include place-specific factors that are expected to impact the way in which individuals use their skills and develop their potential. These place-specific factors can help us explain why some places within Chiapas have managed to accumulate the productive capacities and know-how required by modern production systems, while others have remained stagnant, mostly devoted to subsistence agriculture, highly dependent on social programs.

Our hypothesis is that modern production methods, the ones that allow for higher productivity and better salaries, never made it to the most remote areas of Chiapas. As a consequence, these regions suffer from place-specific constraints, and have fallen into a

sort of chicken-and-egg dilemma: modern industries are not present because these places lack the knowledge and capabilities required, but no one has incentives to acquire the know-how needed by industries that do not yet exist.

One piece of compelling evidence suggesting that education is not the issue comes from analyzing what happened to those workers that migrated out of Chiapas (into the rest of Mexico). Granted, cultural factors have led migration rates in Chiapas to be much lower than the Mexican average. But those that do migrate tend the earn salaries that are similar to those of other internal migrants – controlling for education, experience, gender, or indigenous origins. Therefore, the problem was not their educational attainment, but rather the lack of a complex productive ecosystem in Chiapas, where their capabilities and skills could be deployed.

Our findings suggest that solving the coordination problem embedded in the chicken-and-egg dilemma is essential to jump start the economy of Chiapas, promote structural transformation, and foster convergence. Failure to do so will render the investments the state has made in education fruitless.

The structure of the paper is as follows. In section two we characterize the growth trajectory of Chiapas over the previous decade. Section three is aimed at explaining the income gap in Chiapas as a function of individual factors. In section four and five, we test our argument of place-specific determinants of income gaps between Chiapas and the rest of Mexico and introduce the notion of economic complexity. In section six we dig deeper in explaining the income gap using an Oaxaca-Blinder Decomposition. Section seven is devoted to addressing potential endogeneity concerns between education and economic complexity and estimating bounds for their contribution in explaining the income gap. Conclusions and some policy implications are developed in section eight.

II.   The growth trajectory of Chiapas

Over the decade 2003-2013 Mexico registered one of the lowest growth rates in Latin America. The compounded annual growth rate (CAGR) of the nation in those ten years totaled 1.3%, only higher than Guatemala (1.0%) and Haiti (0.1%).[1] Within that sluggish context, the growth of Chiapas was the lowest among all thirty-two Mexican states, with a CAGR of mere 0.2% (Figure 1). That performance is even more dismal when we consider the non-oil gross domestic product (GDP), as Chiapas registered a negative annual CAGR of 0.2% over the decade, which is in sharp contrast to Mexico's positive CAGR of 1.8%, and even that of Guerrero and Oaxaca (1.4% in both cases), the two poorest states in Mexico right after Chiapas.

Figure 1. Mexican States: Compounded Annual Growth Rate (2003-2013)

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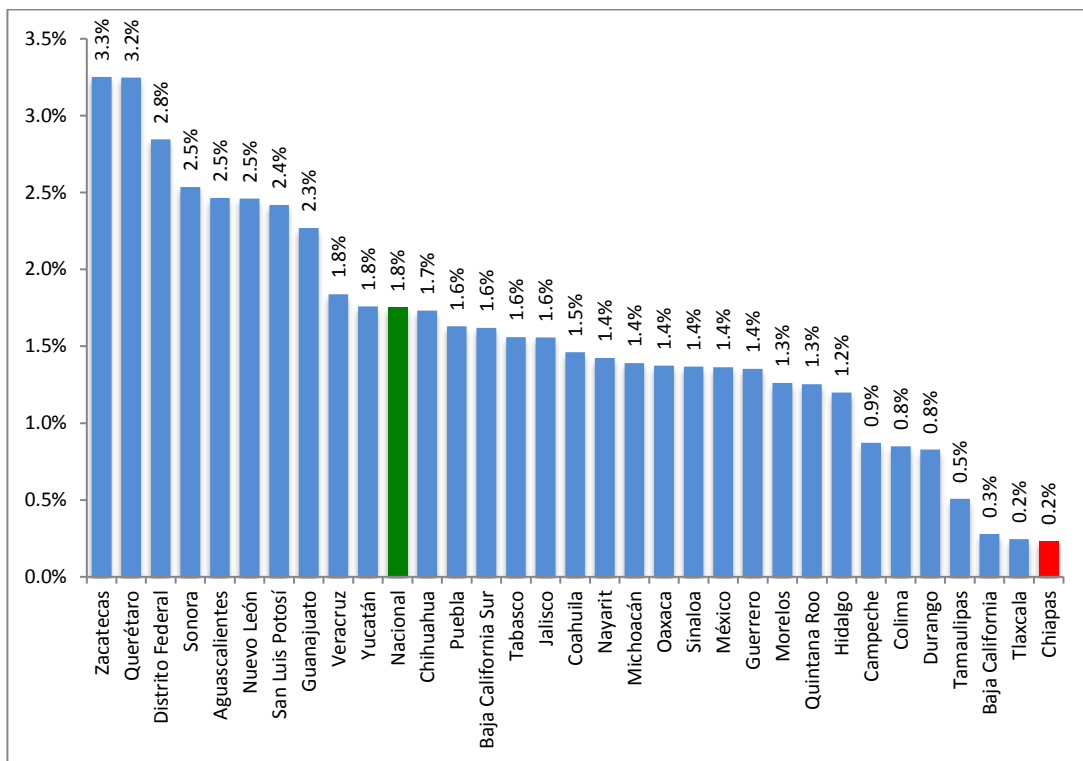
[1] We calculated compounded annual growth rates (CAGR) for 2003-2013 using World Development Indicators. When ranking Latin American countries, we excluded small islands, among which some registered lower CAGR than Mexico: Bahamas (-1.2%), Belize (0.2%), Antigua and Barbuda (0.4%), Saint Lucia (0.4%), Grenada (0.6%), and St. Kitts Nevis (0.9%).

As a consequence, the income gap between Chiapas and the rest of Mexico has been widening. Whereas in 2003 the level of non-oil GDP per capita in Distrito Federal and the Mexican average were 4.7 and 2.2 times that of Chiapas; by 2013 those figures have jumped to 6.3 and 2.5 times, respectively. Over that period, Mexico displayed a divergent pattern, with the more affluent northern states growing at higher rates than the poorest ones, mostly located in the south. Poverty rates mirror the expanding income gap. Either by multidimensional poverty (78.5%) or income poverty (78.1%), Chiapas is by far Mexico's poorest state, with levels well above the national average (46.1% and 51.3%).[2] The differences in income per worker that are evident across Mexican states, reproduce as in a fractal within Chiapas: Tuxtla Gutiérrez, the capital of Chiapas, had an income per capita 8.5 times higher than that of Aldama and Mitontic, Chiapas' poorest municipalities. Therefore, the search for an explanation on why Chiapas is poor must go beyond factors that are invariant at the federal and even state level, such as legal framework, monetary, fiscal, and exchange rate policy,[3] and the banking system. The factors explaining why is Chiapas poor must also be able to account for the large income differences observed within municipalities of Chiapas. These factors can either be associated to the characteristics of individuals or of the particular sub-regional space.

III.   Poverty determinants in Chiapas: Individual characteristics

The traditional approach to explaining why countries and regions are poor either emphasizes nationwide factors or individual (household) factors. Theories based on nationwide factors not only fail to explain large differences in income within countries,

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[2] Fuente: CONEVAL. See also Santos et al., 2015.
[3] Real exchange rate behavior might differ across regions if their inflation rates are significantly different. That is not the case of Chiapas, whose inflation rate was not significantly different from the rest of Mexico over the period studied.

but also large differences within the same state. Accounts that focus on individual characteristics as drivers of income differences, attribute poverty to deficiencies in individual characteristics such as education, experience, endowments, gender, and even indigenous origins (Ravallion, 2015; Milanovic, 2016). In this section, we explore the contribution of some of these individual characteristics to the income gap between Chiapas and the rest of Mexico.

Education

Chiapas is the state with the lowest education attainment in Mexico. By 2010, its labor force had on average 8.1 years of schooling, in contrast to 9.7 years in the rest of Mexico. The bulk of the difference was concentrated on the lowest educational levels. In particular, 13% of the labor force have zero schooling (5% at the national level), 21% did not finish primary school (twice the national average), and 23% did not finish secondary school (20% at the national level).[4] The results from standardized tests ENLACE[5] indicate that Chiapas is among the worst states in Mexico in Spanish language, while it ranks above the national average in mathematics. And yet, there are compelling reasons to believe that education is not the most binding constraint to growth in Chiapas.

First, the magnitude of the difference in years of schooling and experience does not bear any resemblance to the large differences registered in income. By 2010, an average worker in Chiapas had 8.1 years of schooling and 22.5 years of experience; in contrast to 9.7 and 21.5 years in the rest of Mexico, respectively. Given that the years of

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[4] These statistics were calculated based on the Population Census of 2010, and correspond to all individuals with at least 12 years of age and active in the labor force.
[5] ENLACE is a standardized test in Spanish and Mathematics, that the Ministry of Education administered from 2006 to 2013 from grades third to six (last four years of primary school), and last year of secondary school. Between 2009 and 2013, the test was administered across all years of secondary school.

experience are relatively similar, it is reasonable to inquire if the 1.6 years of extra schooling in the rest of Mexico are enough to account for an average income 64.0% higher than their counterparts in Chiapas.

Second, for all schooling levels, income per worker in Chiapas is much lower than in the rest of Mexico (Figure 2). For instance, in order to earn the income of someone with six years of schooling in the rest of Mexico, a worker from Chiapas must have at least ten years of schooling. That is true across all schooling levels, although by eighteen years (equivalent to a Master degree) the distance is somewhat smaller.[6] There must be something in the place that causes individuals with same schooling to consistently earn less in Chiapas than in the rest of Mexico.

Figure 2. Returns to education: Chiapas vs. Rest of Mexico
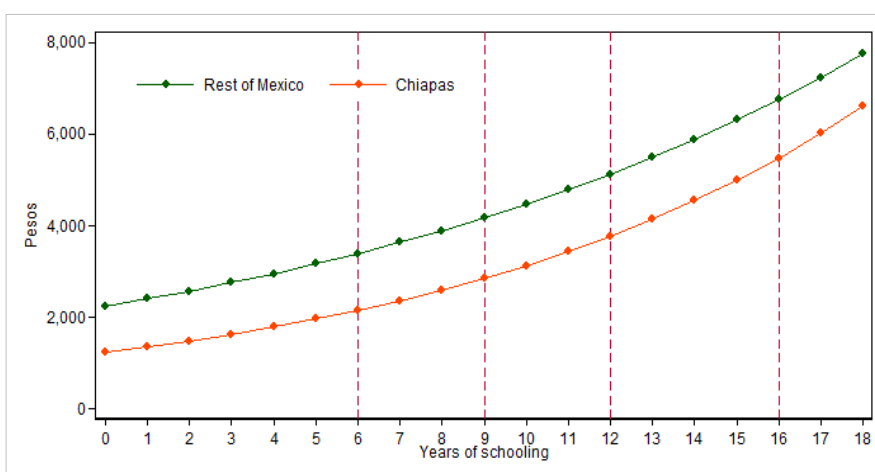
Source: Population census 2010, author's calculations.

Third, the trajectory of the education gap between Chiapas and the rest of Mexico, as measured by years of schooling, does not parallel the evolution of the income gap. As captured in Figure 3, the gap in years of schooling has declined steadily for the cohorts

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[6] These results hold even if we control for the quality of education, measured by ENLACE. The problem is that ENLACE is a more recent test and we shall attribute to cohorts of workers a quality of education that do not necessarily correspond to the education they did receive. The results are available from the authors upon request.

born after 1965. The trend, that shrinks at an accelerated pace for the cohort born in the late eighties, went from 3.2 years on average (cohort born in 1965) to 1.6 (1987).

Figure 3. Schooling by cohort and schooling gap
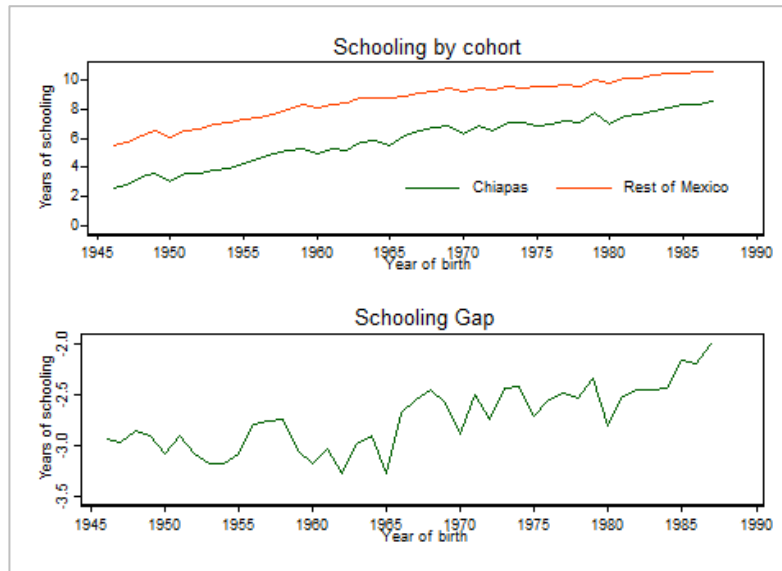
Source: Population census 2010, author's calculations.

At last, education cannot account for the fact that the wage premium between workers in Chiapas and the rest of Mexico shrinks when we look at the income of internal migrants coming from Chiapas. To begin with, a worker elsewhere in Mexico makes on average a 67.6% premium with respect to workers in Chiapas. If workers born and educated in Chiapas migrate and work somewhere else in Mexico, they make on average 79.7% more than those that stayed back in Chiapas (panel a of Figure 4). Now, one might say that migrants self-select, and only the best suited in the population venture out of the state in search for opportunities. By restricting our comparison to wages of migrants we account for that possibility: Migrant workers from Chiapas make just 11.2% less than other internal migrants coming from elsewhere in Mexico (panel b of Figure 4).

Figure 4. Migrants incomes: Chiapas vs. Rest of Mexico

Panel a) Workers from Chiapas vs. Rest of México
Panel b) Migrants coming Chiapas vs. Rest of México

Source: Population census, 2010
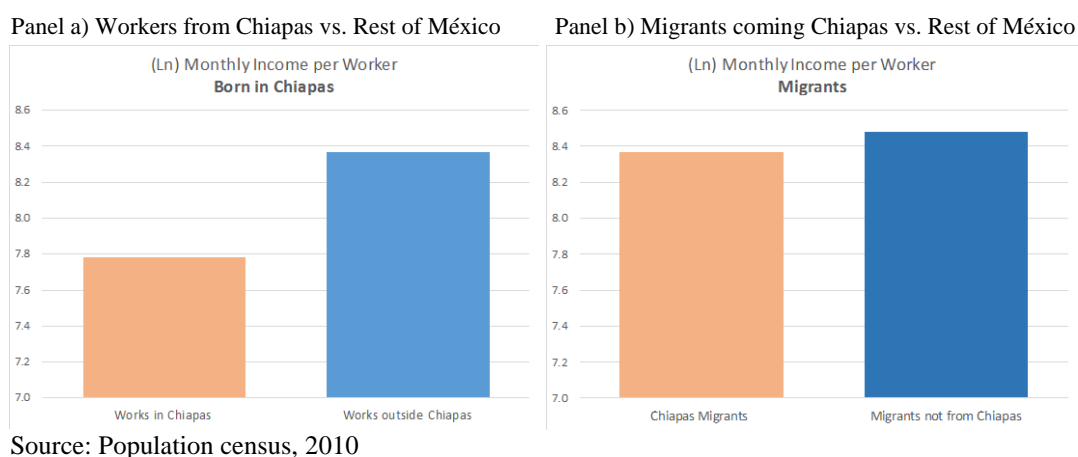
The differences observed in Figure 4 might be driven by differences in the profiles of migrants from Chiapas and the rest of Mexico. For instance, it might be the case that Chiapas migrants are better educated or have more experience than other internal migrants. In order to account for the impact of these and other factors, we ran a regression of incomes derived from work on internal migrants coming from Chiapas and elsewhere, controlling for individual factors such as years of schooling, experience, gender, indigenous language and rural location on wages. Our data comes from the 10% microdata sample of the 2010 Population Census carried out by the National Institute of Statistics and Geography of Mexico (INEGI).[7] We have restricted our sample to the population between 12 and 99 years old that declared having a positive monthly income derived from work.[8] Our final sample has 3,005,859 individuals, and our analysis has been done using the corresponding expansion factors provided by INEGI. Given that the sample has the income variable truncated from above at 999,999 pesos per month (US$ 80,000), we have chosen a Tobit specification. We measure the impacts of these on the income derived from work in Mexico at the municipality level, and include in each case

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[7] INEGI: Instituto Nacional de Estadística y Geografía.
[8] Twelve years is the threshold used by INEGI in their labor market statistics.

an interaction with a dummy indicating if the subject was born in Chiapas in order to capture the incremental impacts (with respect to the national average) to workers within the state. Results are reported in Table 1.

Once we control for other variables that potentially influence labor income, we can see that wage differences largely disappears. Let us assume the average salary per worker in Mexico is equal to 100 – 67.6% higher than that of Chiapas' workers, which in that scale would earn 59.6. When a worker migrates into another state of the Mexican union, she earns a premium of 13.9 percentage points (the coefficient of *Migrant* in specification 1), for a total of 113.9. A worker from Chiapas gets an average premium of 51.2 percentage points when migrating to other Mexican state (the sum of coefficients of *Migrant* and the one of interaction *Chiapas-Migrant* in specification 2), ending with a total salary of 110.9. When comparing *chiapanecos* working out of Chiapas with other Mexican workers working out of their state of origin, the wage difference shrinks to 2.7%. That is to say that Chiapas migrants make a salary that is roughly similar to other internal migrant workers in Mexico with similar schooling, experience, gender and indigenous origin.

In spite of the good fortune that accompanies Chiapas' workers when they venture out of the State, migration rates are significantly lower. That is particularly true in rural areas, where the migration ratio (1.42 per 1,000 inhabitants) is less than half elsewhere in rural Mexico (3.42). Why do rural *chiapanecos* not migrate more often? From our field experience in Chiapas we have derived three complementary hypotheses. First, because the safe combination of cheaper cost of living, subsistence agriculture and conditional cash transfer programs (*Prospera[9]*), provides a sharp contrast to the risk profile of

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[9] *Prospera* is a federal program of conditional cash transfers aimed at families in extreme poverty. The program brings together different institutions at the federal and regional level, including

migrating to urban areas out of the State. Second, because indigenous people in Chiapas are usually located at *ejidos*, or communal property. The fact that they benefit from usage but cannot sell or rent property raises the opportunity cost of an eventual migration. At last, many of these communities are governed by the system of *Usos y Costumbres*, a form of self-determination where indigenous authorities enforce a set of particular rules that regulate life in the villages. Although there are different *Usos y Costumbres* depending on the ethnic groups, most of them contemplate cash-penalties for migration. These penalties are imposed upon the family of the migrant, and failure to comply may lead to loss of property assigned to the family and even expulsion (Santos, Dal Buoni, Lusetti, and Garriga, 2015).

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the Secretary of Public Education, Secretary of Public Health, Mexican Institute of Social Security, as well as State and municipal governments. It was launched in 1998 and changed its name multiple times, going from *Solidaridad* (1988-2002), *Progresa* (2002 a 2007) and *Oportunidades* (2007 a 2014), to *Prospera* (2014 until present). According to figures provided by the office of Prospera in San Juan Chamula, by 2014 Cruzton had a total of 447 families, totaling 1,636 people, registered as beneficiaries of the program.

Table 1. Tobit regression of income per worker and migrants, controlling for years of schooling, experience, gender, indigenous origins for Chiapas and the rest of Mexico

	(1)	(2)	(3)
Years of Schooling	0.095***	0.095***	0.095***
	335.17	335.06	325.79
Experience	0.032***	0.032***	0.032***
	310.78	311.13	310.98
Experience-squared	-0.000***	-0.000***	-0.000***
	-241.36	-241.16	-241.23
Female	-0.337***	-0.337***	-0.340***
	-258.12	-259.59	-266.92
Indigenous Language	-0.262***	-0.260***	-0.250***
	-33.45	-33.94	-46.64
Born in Chiapas	-0.269***	-0.346***	-0.406***
	-25.22	-27.01	-24.04
Migrant	0.139***	0.128***	0.128***
	66.68	61.21	61.23
Migrant*Chiapas		0.384***	0.371***
		23.74	27.57
Years of Schooling*Chiapas			0.005***
			5.12
Experience*Chiapas			0.000
			0.07
Female*Chiapas			0.102***
			9.06
Indigenous*Chiapas			-0.104
			-1.63
Constant	7.125***	7.126***	7.129***
	2042.65	2041.53	2004.13
Observations	3,005,931	3,005,931	3,005,931

t values are indicated beneath the coefficients.
*** p<0.01, ** p<0.05, * p<0.1

Indigenous origins

Another individual factor that is often mentioned when it comes to explaining why workers in Chiapas earn lower salaries is the indigenous origin of a significant share of its population. Granted, after Oaxaca (35%) and Yucatan (33%), Chiapas has the third largest share of individuals speaking an indigenous language among all Mexican states, which we use as a proxy for indigenous origins. The five most important languages spoken in Chiapas are Tzeltal (37% of total population speaking an indigenous language), Tzotzil (34%), Chol (16%), Tojolabal (5%) y Zoque (5%). All but the latter belong to the Maya linguistic family.

The results in Table 1 indicate that individuals speaking indigenous languages do earn wages that are 25% lower than otherwise, but there is no evidence indicating that indigenous people in Chiapas are significantly worse than their counterparts elsewhere in Mexico. The coefficient of the interaction between indigenous language and been born in Chiapas is negative (-0.104 in specification 3), but is not significant in spite of the large number of observations.

The methodological challenge here lies in differentiating individual characteristics (belonging to an indigenous culture, or being able to speak an indigenous language) from the characteristics of the places where these communities live, mostly rural and devoted to subsistence agriculture. In order to address that, we use the Oaxaca-Blinder method to decompose the differences in average income between Chiapas workers and those from rest of Mexico (Blinder, 1973; Oaxaca 1973). Intuitively, the Oaxaca-Blinder decomposition aims at explaining what would happen if workers from Chiapas had the same average features (schooling, experience, shares of female, indigenous, and people living in rural areas) observed in the rest of Mexico.

The results are reported in two different forms in Table 2. The left-hand side panel (columns 1 and 2) decomposes the difference in the log of mean income in three components: characteristics, coefficients, and interactions. The right-hand side panel (column 3 and 4) contains a similar decomposition but instead of logs, results are presented in percentage terms. The rows of the coefficients represent what would happen if we endowed Chiapas workers with the average level observed for each characteristic in the rest of Mexico. The coefficient row represents what would happen if we were to give Chiapas workers the same returns observed in the rest of Mexico for these characteristics. At last, the interaction panel represents what would happen to Chiapas workers if they were endowed with the same impact of the interactions between characteristics and coefficients observed in the rest of Mexico.

The number of people speaking an indigenous language only explains a fraction of the difference in mean income between Chiapas and the rest of Mexico. More explicitly, we find that differences in the number of indigenous people – considering all impacts coming from characteristics (10.3%) and interactions (-2.3%) – only represents a small fraction (8.0%) of the total difference in income observed between these places (64.0%). These results are in line with de Janvry and Saudolet (1996), de Janvry, Gordillo and Sadoulet (1997), and the World Bank (2005), all reporting that indigenous origins do not explain why Chiapas is poorer than the rest of Mexico.
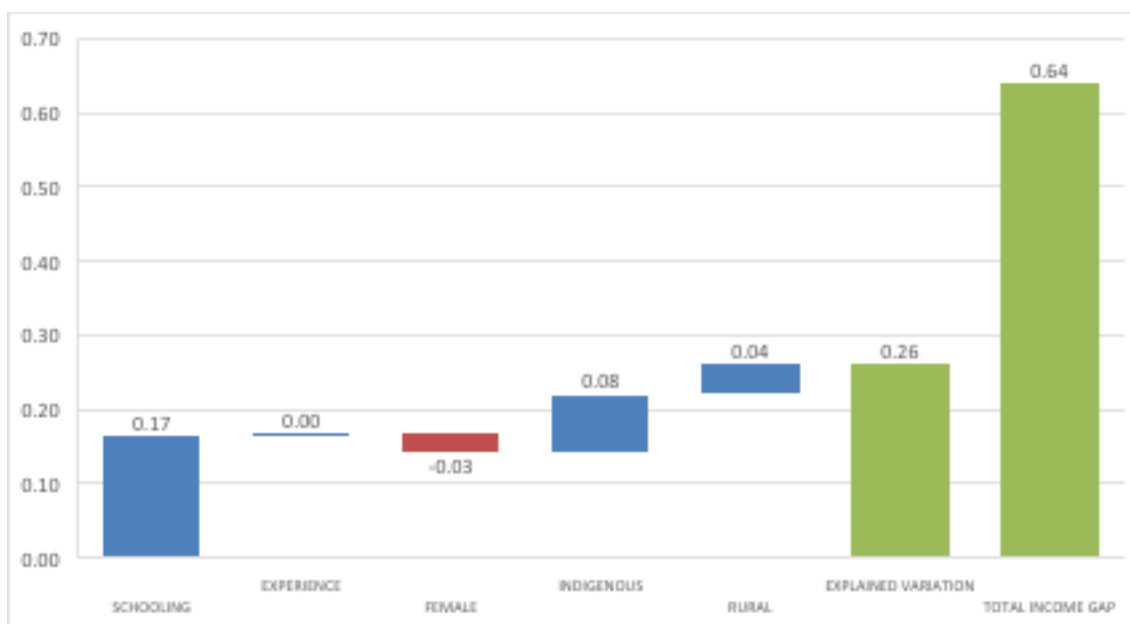
Table 2. Oaxaca-Blinder decomposition: Factors associated to differences in the mean of income per worker Chiapas vs. Rest of Mexico

	(1) Decomposition Coefficient	(2) Standard Error	(3) Decomposition Coefficient	(4) Standard Error
Difference log(income)	0.640	0.003	1.897	0.006
Blinder-Oaxaca				
Characteristics	0.314	0.002	1.368	0.003
Coefficients	0.377	0.003	1.458	0.004
Interactions	-0.050	0.002	0.951	0.002
Characteristics				
Schooling	0.180	0.002	1.198	0.002
Experience	0.002	0.000	1.002	0.000
Female	-0.020	0.001	0.980	0.001
Indigenous Language	0.103	0.001	1.108	0.002
Rural	0.049	0.001	1.050	0.001
Coefficients				
Schooling	-0.048	0.004	0.953	0.004
Experience	0.007	0.006	1.075	0.007
Female	-0.016	0.001	0.984	0.001
Indigenous Language	0.034	0.002	1.035	0.002
Rural	0.018	0.003	1.018	0.003
Constant	0.317	0.011	1.373	0.015
Interactions				
Schooling	-0.014	0.001	0.986	0.001
Experience	0.001	0.000	1.001	0.000
Female	-0.007	0.001	0.993	0.001
Indigenous Language	-0.023	0.001	0.977	0.001
Rural	-0.007	0.001	0.993	0.001

The results in Table 2 provide two additional relevant insights on our quest to understand why Chiapas is poor. First, the total impact of differentials in the shares of population living in rural environments is able to explain even a smaller fraction (4.2 percentage points) than the indigenous origin itself. Second, even considering all these individual factors (schooling, experience, gender, indigenous origins), plus one place-

specific characteristic (rural environment), we are only able to account for 40% of the premium (26.4 out of 64.0 percentage points) that workers in Mexico exhibit with respect to those in Chiapas. As portrayed in Figure 5, after accounting for differences in all these factors, a sizable part of the gap (37.6 out of 64.0 percentage points) remains unexplained.

Figure 5. Oaxaca-Decomposition: Contribution of individual factors in explaining the income differences between Chiapas and the rest of Mexico

Source: Data used in the Oaxaca-Blinder decomposition comes from the 10% sample of the 2010 Population Census, and has been used applying the corresponding weights.

IV.   Place-specific determinants of poverty

The results reported in the previous section indicate that individual factors only account for 40% of the differences in the income of works of between Chiapas and the rest of Mexico. In this section, we explore the role of factors associated to characteristics of the place.

The usual suspects: Market failures in the credit market and poor infrastructure

Two factors that are usual suspects when it comes to explaining difference in income across places are credit markets and infrastructure. None of them seem to play a significant role in explaining why Chiapas is poor.

The share of households and firms (or economic units, EU for short) which got external financing in Chiapas in 2008, as well as those financed through banks, is close to the national average. According to Economic Census 2009, around 30% of Chiapas' EUs did not have financing in 2008, versus 28% at the national level. However, this measurement includes funds provided by partners or owners of the company, which is more a capital investment than a credit. When we only consider external financing, Chiapas fell slightly under the national average. Similarly, 32% of EUs that secured external credit did it through banks, which is in line with the national average, and right in the middle of the national spectrum (going from 19% in Oaxaca, to 52% in Nuevo Leon). Credit access in Chiapas does not look different than in the rest of Mexico.

Moreover, growth constraints shall be detected by analyzing both quantities and prices. As it turns out, the cost of credit in Chiapas is among the lowest of all entities in Mexico, throughout the spectrum of enterprise sizes. Real interest rates in the state – based on the official statistics published by INEGI on nominal interest rates and inflation by state – are also below the national average by a range that goes from 0.7 (small and medium enterprises) to 1.9 percentage points (large enterprises). The empirical evidence indicates that low levels of credit to the private sector in Chiapas are driven by the low productivity of its economy, and are not the consequence of bottlenecks in credit markets or insufficient credit supply (Hausmann, Espinoza y Santos, 2015).

The other usual suspect when it comes to place-specific determinants of poverty is poor infrastructure. Chiapas is traversed from north-west to south-east by two mountain ranges, that create very distinct climatic zones and represent a challenge to the build-up and maintenance of infrastructure. In spite of that, we have found no evidence of infrastructure being the most significant binding constraint in Chiapas. The large amount

of resources and policy attention devoted to the State after the Zapatista upraise did translate into significant improvements in the provision of infrastructure.

Taking into account area and population, Chiapas ranks above the Mexican average in terms of paved roads and four-lane roads. Fifteen years ago, Davila, Kessel and Levy (2002) identified the radial nature of most roads in Mexico with respect to its capital, as one of the most important constraints to the development of the South. The authors suggested a number of infrastructure developments to overcome this obstacle, that would have produced savings in distance and time. By the end of 2013 most of these projects have been completed. As reported by Hausmann, Espinoza and Santos (2015), the savings in distance and time associated to these infrastructure developments were not only achieved, but in some cases even surpassed. And yet, as it happened with schooling, none of these improvements translated into higher incomes or lower poverty rates.

During the course of our fieldwork in Chiapas we did find significant constraints when it came to labor mobility, not because of road deficiencies but rather driven by the absence of public transportation. Workers living in rural villages surrounding Chiapas' most important cities – Tuxtla Gutierrez, Tapachula, San Cristobal de las Casas, Comitan de Dominguez, and Palenque – must ride in shared private taxis if they want to work in these urban centers. These transportation costs operate as a regressive tax on workers in nearby rural areas: Given that the cost is fixed, it ends up being prohibitive for those workers performing less sophisticated tasks (and therefore earning lower salaries).

Consider the example Cruzton, a rural village in the municipality of San Juan Chamula, just fifteen minutes away from San Cristobal de las Casas. According to the population census, by 2010 Cruzton had 1,756 inhabitants, grouped into 340 family units (5.16 members per family), most of them poor and beneficiaries of the conditional cash-

transfer program Prospera. The bulk of its population (83.5%) belongs to the Tzotzil tribe, who claim to be one of the first indigenous groups in Chiapas, and therefore name themselves *batsiviniketik* ("true man").

If people from Cruzton want to work in the San Cristobal de las Casas' labor market, the only mean available is a private shared-taxi that in late 2015 was priced at twenty Mexican pesos each way. Figure 6 comprises the most common occupations in Cruzton, as surveyed by Santos, Dal Buoni, Lusetti, y Garriga (2015). On the far right we find the average wage in San Cristobal de las Casas paid to laundry, harvesting, and construction workers. For them, transportation costs are the equivalent of a 53% - 80% tax on their potential daily wage in the urban center, which forces them to stay at Cruzton where they find much less work at lower equilibrium wages. On the left side of the scale are the only occupations that would most likely justify paying transportation cost of this size: school principals, teachers, or Prospera workers. For them, transportation costs represent a 13% - 20% tax on their potential daily wage. Road infrastructure is not a problem. In fact, the road covering the 6.5 miles separating Cruzton from San Cristobal is in good shape. The problem is the lack of public transportation, which is preventing those that need it most from joining the much larger San Cristobal labor market.

Figure 6. Cruzton, Chamula: Daily wages and transportation costs

(40 pesos round trip in shared cab)
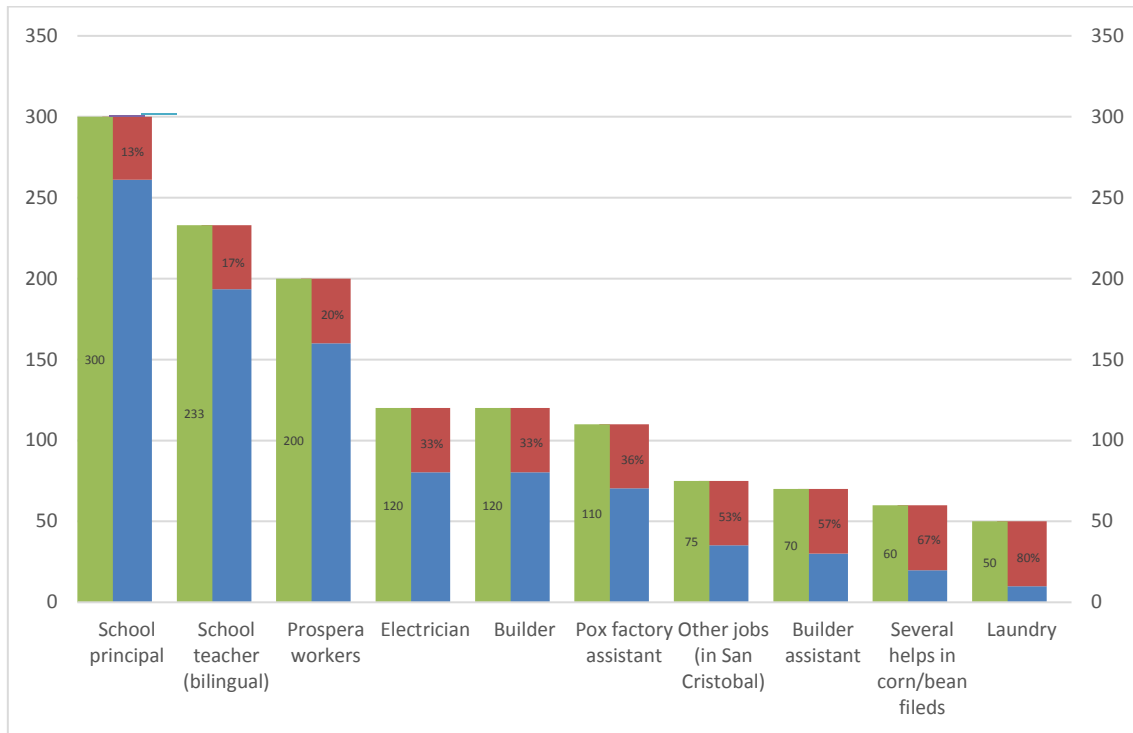
In sum, over the previous two decades there has seen a significant flow of public investment in Chiapas, that has reduced the schooling gap, increased access to credit and improved its infrastructure. As these developments were taking place, the income gap separating Chiapas workers from their counterparts in Mexico widened. Other than the lack of complementary transport infrastructure, neither individual factors nor traditional place-specific factors are able to explain why Chiapas has become poorer. To address this issue, in the next section we introduce a new indicator of economic complexity to capture place-specific determinants of income gaps.

V.   Economic Complexity

The export basket of a country or region is an indicator of the productive capacities and know-how of a place.[10] The more diverse the export basket of a place, the more diverse the capacities and know-how it possesses. The idea that this may be the key to understand the differences in productivity across places was first introduced by Hidalgo and Hausmann (2009). Given that productive capacities are not always tradable, the differences in productivities and incomes can be explained by differences in their Economic Complexity Index (ECI). According to these authors, ECI is a measure of knowledge agglomeration that mirrors the diversity and uniqueness of the productive capacities of a place.

The calculation of ECI requires first to assess what products are done or not in a place. To turn production into a binary variable, Hidalgo and Hausmann use Balassa's Revealed Competitive Advantage (RCA)[11]. According to this measure, a country or place c has a comparative advantage (RCA>1) in the manufacturing of product i in any given year, when the importance of that good within its export basket is higher than the one of that same good in the world´s export basket. The measure is calculated as follows,

$$RCA_{c,i} = \frac{\dfrac{X_{c,i}}{\sum_i X_{c,i}}}{\dfrac{\sum_c X_{c,i}}{\sum_{c,i} X_{c,i}}}$$

We will define two place-specific parameters, depending on whether the products each place is able to produce and manufacture with positive RCA. One is *diversity*: the number of products a country or region is able to produce with RCA>1; and the other is the *ubiquity,* calculated as the number of countries or places that are able to manufacture

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[10] In general, we will use exports for any good sold outside Mexico, and will use industries to include the value of goods and services produced by a State and sold locally to other States in Mexico.

[11] See Ballasa (1964).

that product with RCA>1. Empirically, there is an inverse relationship between ubiquity and diversity prevailing at both national (i.e. comparing exports across countries) and sub-national level (e.g. comparing production across states or cities within countries). Countries with a larger variety of productive capacities are able to manufacture not only a more diverse array of products, but also products that are, on average, produced in fewer places. In contrast, places that have a few productive capacities and little know-how, not only will be able to manufacture a relatively low number of goods (low variety), but those will also be goods produced in many places (high ubiquity). Figure 7 displays the diversity and average ubiquity of the products exported with comparative advantage (RCA>1). In the figure of the 32 Mexican States is shown, and Chiapas is highlighted using a red triangle, and – as expected – there is a negative relation between the average ubiquity of products produced with comparative advantage (Y axis) and the diversity of production in each state (X axis).

Figure 7. Diversity and Ubiquity for Mexican States (2014)
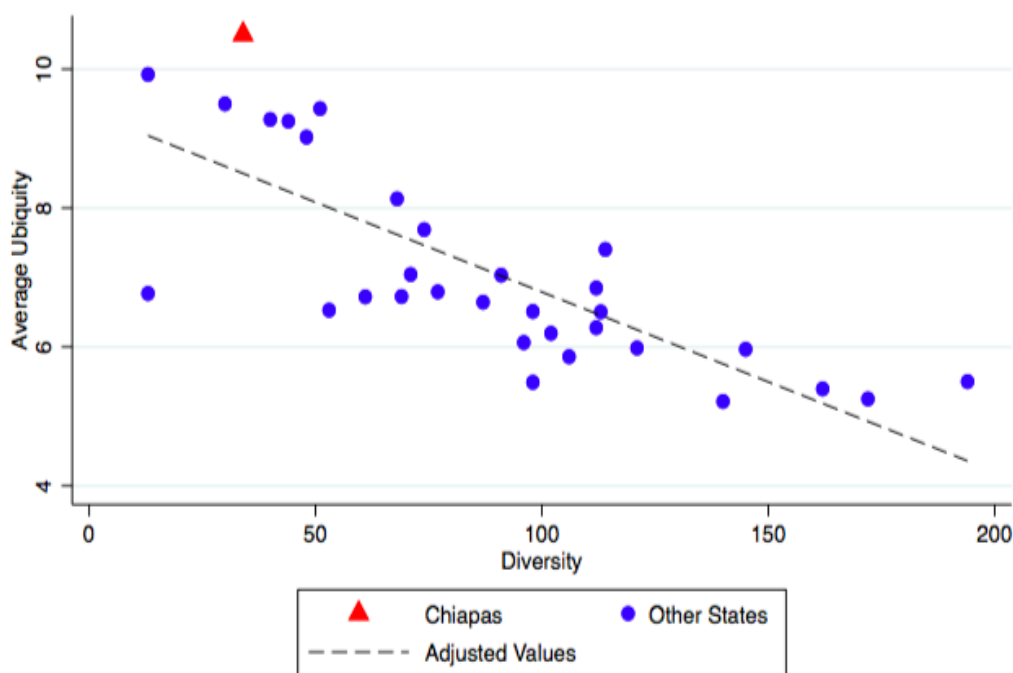
Source: Authors calculations based on the Atlas of Economic Complexity of Mexico

Chiapas, Tabasco, and Zacatecas produce the lower variety of goods, and those they produce are in turn goods that on average many places are able to manufacture. At the other end of the spectrum, Distrito Federal, Nuevo León and Jalisco produce a large number of goods that are, on average, the least ubiquitous products. From this standpoint, the challenge posed by development is two-fold: how to diversify the productive structure and, at the same time, being able to produce goods that on average very few places are able to make.

Now that we have a binary way to asses to is produced or not in a location, we define M_{cp} as a matrix containing 1 if the country produces good p with RCA>1, and 0 otherwise. The diversity and ubiquity result from adding rows and columns (respectively) of that matrix. More formally, let us define:

$$Diversity = k_{c,0} = \sum_p M_{cp}$$

$$Ubiquity = k_{p,0} = \sum_c M_{cp}$$

In order to generate an indicator of the capacities and know-how accumulated in a place or required to manufacture a certain product, we need to use the information contained in the ubiquity of a product to correct for the content embedded in diversity. For countries, we need to calculate the average ubiquity of its basket of exports, and the average diversity of the countries that export those same goods, and so on. For products, we need to calculate the average diversity of countries that manufacture those products, and the average ubiquity of the other products that those countries are able to make. This iterative process will help us, for instance, not to consider natural resources as complex goods, just because very few countries are able to export it competitively. The correction comes by factoring in the diversity of the export basket of countries that export a natural resource, i.e. natural resource exporters are usually not able to manufacture a large variety

of exports with RCA>1. The iteration between ubiquity and diversity described above

can be expressed in a recursive form as:

$$k_{c,N} = \frac{1}{k_{c,0}} \sum_p M_{cp} k_{p,N-1} \tag{1}$$

$$k_{p,N} = \frac{1}{k_{p,0}} \sum_c M_{cp} k_{c,N-1} \tag{2}$$

Inserting (2) in (1) we obtain:

$$k_{c,N} = \frac{1}{k_{c,0}} \sum_p M_{cp} \frac{1}{k_{p,0}} \sum_{c\prime} M_{c\prime p} k_{c\prime,N-2} \tag{3}$$

$$k_{c,N} = \sum_{c\prime} k_{c\prime,N-2} \sum_p \frac{M_{cp} M_{c\prime p}}{k_{c,0} k_{p,0}} \tag{4}$$

That in turn can be written as:

$$k_{c,N} = \sum_{c\prime} \widetilde{M}_{cc\prime} k_{c\prime,N-2} \tag{5}$$

where

$$\widetilde{M}_{cc\prime} = \sum_p \frac{M_{cp} M_{c\prime p}}{k_{c,0} k_{p,0}} \tag{6}$$

Note that (6) is only satisfied when $k_{c,N} = k_{c,N-2} = 1$. That is the *eigenvector* of

$\widetilde{M}_{cc\prime}$ associated with the higher *eigenvalue*. Given that this *eigenvector* is a vector of 1, it

is not informative. Instead, we will search for the *eigenvector* associated with the second

higher *eigenvalue*. That *eigenvector* captures the highest quantity of information in the

system, and therefore will be our measure of economic complexity.[12] Our Economic

Complexity Index will therefore be defined as:

$$ECI = eigenvector\ asscoaietd\ with\ the\ second\ highest\ eigenvalue\ of\ \widetilde{M}_{cc\prime} \tag{7}$$

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[12] Hidalgo and Hausmann (2009) introduced the Economic Complexity index using an iterative
calculation, while Hidalgo eta al (2011,2014) shows that the system converges and its solution
is the second eigenvector. Both solutions are equivalent.

We have calculated export-based ECI for all 32 Mexican States. Exports by State are available by the Mexican Atlas of Economic Complexity[13] and have been allocated based on customs data provided by the Mexican Tax Authority (*Servicio de Administración Tributaria* or SAT)[14]. The results are reported in Figure 8. In this case, RCAs have been calculated using the share of goods in world trade in the denominator. The fact that most Mexican entities have ECI larger than 1 is an indicator that they are more complex than the average country at the worldwide level.

According to Figure 8, Chiapas is one of the states with lower economic complexity in Mexico, ranking third from bottom only above Sinaloa and Nayarit. Its exports are mostly composed of primary products that require little know-how, such as oil and derivatives (50.4%), and agricultural goods (36.1%) such as coffee, avocados, pineapples, sugarcane and bananas, among others. Its low ECI is the result of a very limited variety of export products that on average many places are able to make.

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[13] http://complejidad.datos.gob.mx

[14] The allocation is based on the fiscal address provided by the exporting firm to the tax authority service in Mexico (SAT). In those cases where there is not a fiscal address available on the database of SAT, the address provided to the Mexican Institute of Social Security has been used. In the case of companies with more than one plant in Mexico, the exports have been allocated by State using shares of formal workers of each plant.

Figure 8. Economic Complexity Exports
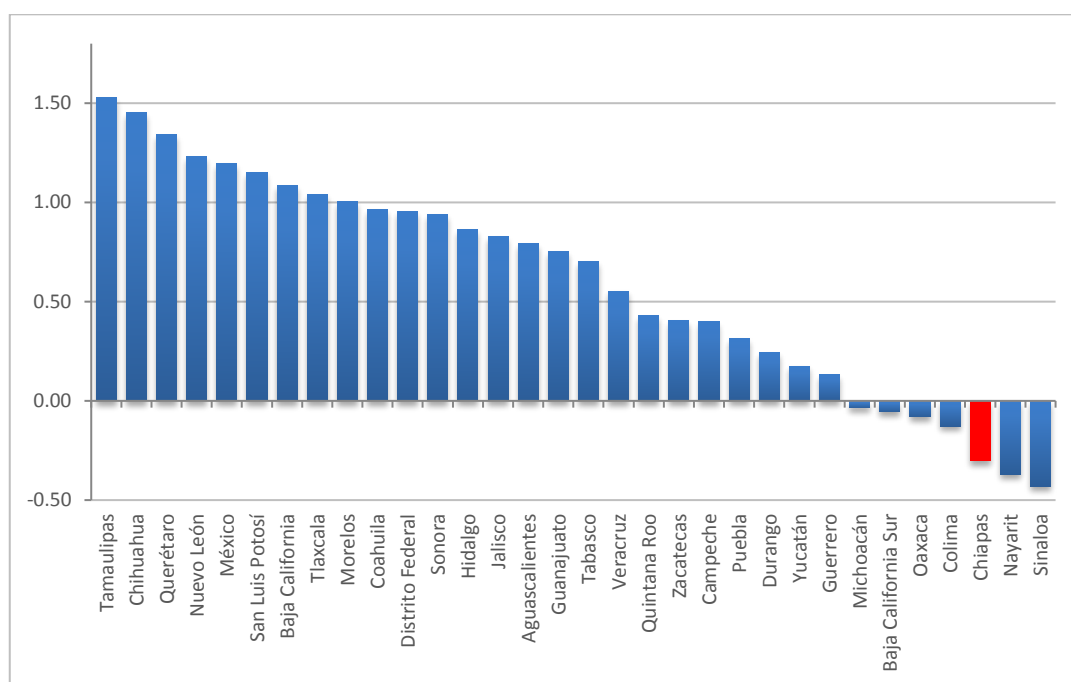
Source: http://complejidad.datos.gob.mx, author's own calculations.

The export-based ECI, as a measure of collective know-how, has two limitations. First, it does not take into account productive capabilities that are employed in non-tradable-sectors. Second, there might be capabilities embedded in manufacturing products that are sold in other places of Mexico – "exported" out of the State – but not out of the country. The latter might be particularly important when we try to measure the productive capabilities of sub-national units, such as Chiapas.

One way to overcome these shortcomings consist in calculating employment-based ECI. We can calculate RCAs based on relative intensities of employment instead of exports. Accordingly, we would measure the intensity of employment in a certain activity in a state, with respect to its average intensity in Mexico. While this approach allows us to circumvent some of the flaws of the export-based ECI (taking into account knowledge embedded in non-tradable sectors), it ignores the fact that there might be important industries in the world that do not exist in Mexico. In spite of that, given our

interest in analyzing income gaps at the municipal level in Mexico, and that fact that many municipalities do not export any goods, we have chosen the latter measure of complexity because of its granularity at the subnational level. That is an important feature. As mentioned earlier, the explanation to why Chiapas is poorer than the rest of Mexico should also be able to account for the large income differences observed within Chiapas. The results of this approach are reported in Figure 9. Given that we are using as a reference the average employment intensity per activity in Mexico, now the States align symmetrically around zero. The situation for Chiapas does not change much, as the State continues to rank third from bottom, only above Campeche and Quintana Roo.

Figure 9. Economic Complexity of Industries (Employment-based)
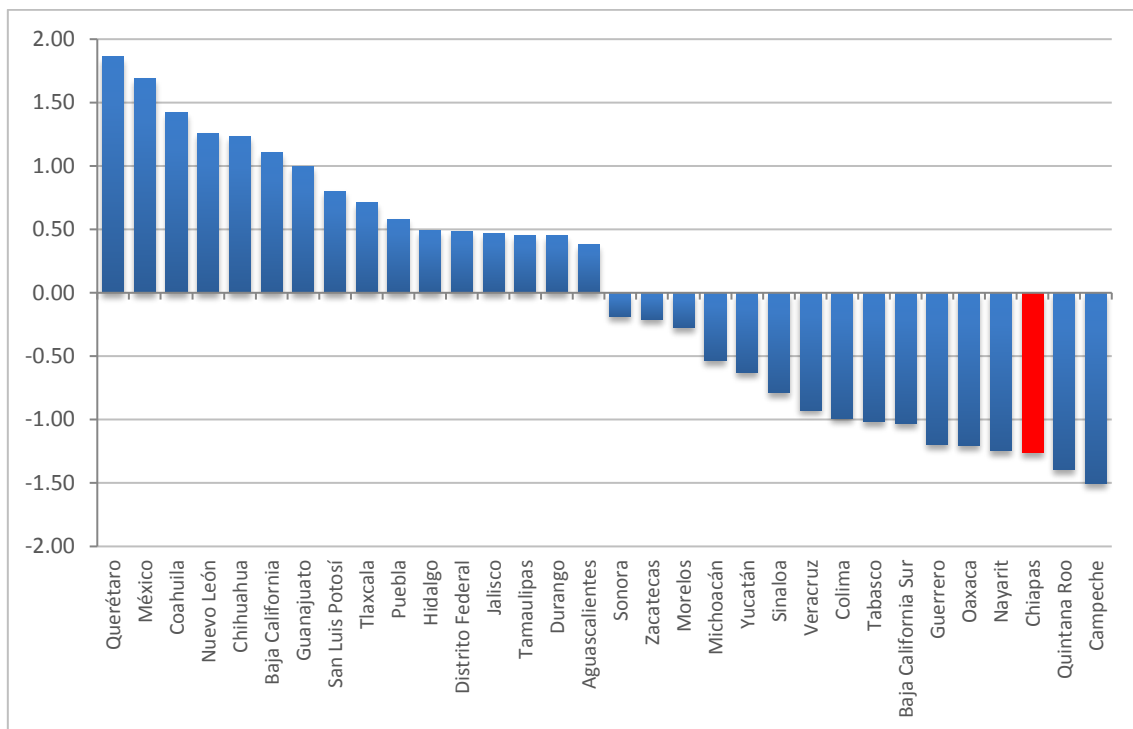
Source: http:/complejidad.datos.gob.mx, author's own calculations.

VI. Place-specific determinants of the income gap: Economic Complexity

There are two levels of sub-State aggregation at which we can calculate employment-based ECI. One possibility was to work at the region level, as Chiapas has a large number of municipalities (122) divided into nine geopolitical regions. To test the validity of this approach, we ran a variance decomposition analysis. As it turns out, when income differences within regions of Chiapas are broken down, 75% of the difference occurs at the intra-regional level, and only 25% across regions. That is to say, even within these nine geopolitical regions there exist a large variance of workers' incomes that call for a municipal approach. We therefore proceeded to calculate employment-based ECIs at the municipal level in Chiapas using employment data coming from the 10% sample of the 2010 population census. As can be ascertained in Figure 10, municipal-ECI does display a large degree of variety within Chiapas, and can therefore be a candidate to explain the large differences in income observed across municipalities in Chiapas.

Figure 10. Economic Complexity of Chiapas at the municipal level
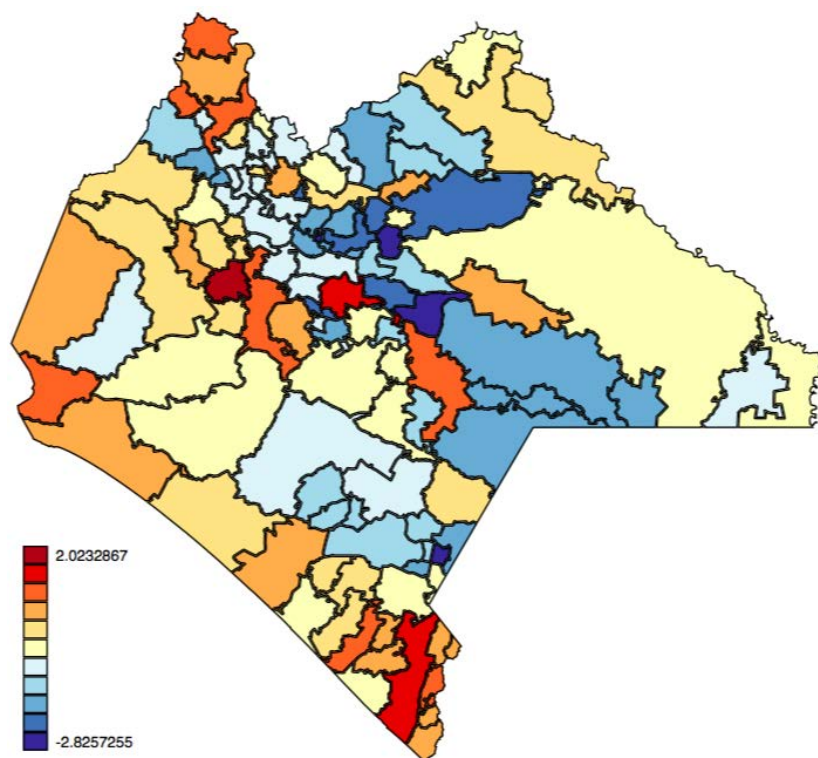
Source: 2010 Population Census, authors' own calculations.

Adding the ECI corresponding to the municipality of the worker, and using the same database as in Table 2, we run the Oaxaca-Blinder decomposition to see if we can explain a higher share of the observed income gap. The results are reported in Table 3. The Economic Complexity of the place is able to explain a large fraction of the income gap (15.3 percentage points). The most salient features of Table 3 and the size and sign of the characteristics, coefficients and interactions of the remaining variables is roughly similar to that of Table 2. Two significant differences are noteworthy. First, Economic Complexity accounts for a share of the income gap roughly similar to following education, larger than all other factors. Second, the total explained variation went from 41% (26.4 out of 64.0 percentage points) in Table 2 to 55% (35.1 out of 64.0 percentage points).

Table 3. Oaxaca-Blinder decomposition using the Economic Complexity Index: Factors associated to differences in the mean of income per worker Chiapas vs. Rest of Mexico

	(1) Decomposition Coefficient	(2) Standard Error	(3) Decomposition Coefficient	(4) Standard Error
Difference log(income)	0.640	0.003	1.897	0.006
Blinder-Oaxaca				
Characteristics	0.449	0.003	1.566	0.005
Coefficients	0.289	0.003	1.336	0.003
Interactions	-0.098	0.003	0.907	0.002
Characteristics				
Schooling	0.173	0.002	1.189	0.002
Experience	0.002	0.000	1.002	0.000
Female	-0.024	0.001	0.976	0.001
Indigenous Language	0.052	0.002	1.054	0.002
Rural	0.036	0.001	1.037	0.001
ECI	0.209	0.003	1.233	0.004
Coefficients				
Schooling	-0.062	0.004	0.940	0.004
Experience	0.061	0.006	1.063	0.007
Female	-0.010	0.001	0.990	0.001
Indigenous Language	0.001	0.002	1.001	0.002
Rural	0.051	0.003	1.052	0.003
ECI	0.016	0.001	1.016	0.001
Constant	0.231	0.011	1.260	0.013
Interactions				
Schooling	-0.018	0.001	0.983	0.001
Experience	0.001	0.000	1.001	0.000
Female	-0.004	0.001	0.996	0.001
Indigenous Language	-0.001	0.002	0.999	0.002
Rural	-0.019	0.001	0.981	0.001
ECI	-0.056	0.003	0.945	0.003

Figure 11. Oaxaca-Decomposition: Contribution of economic complexity in explaining the income differences between Chiapas and the Rest of Mexico
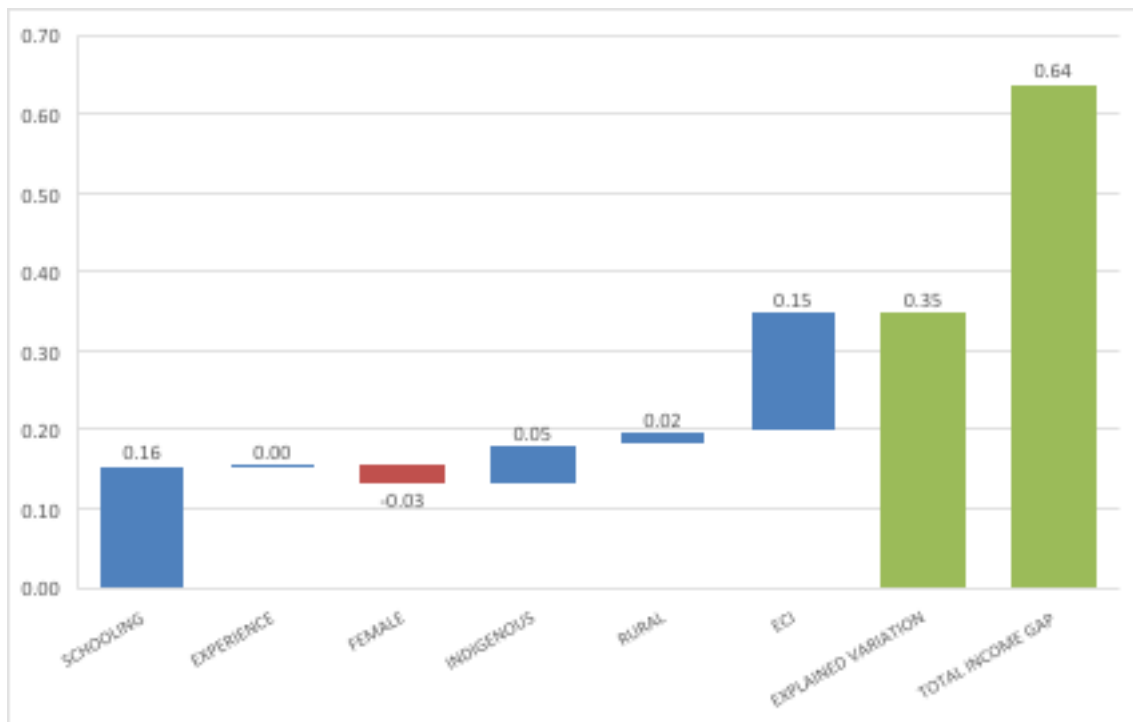
Source: Data used in the Oaxaca-Blinder decomposition comes from the 10% sample of the 2010 Population Census, and has been used applying the corresponding weights.

VII. Addressing potential endogeneity between education and ECI

Since we are interested in discriminating the contribution of individual from place-specific factors in explaining income gaps, it is essential that we deal with the endogeneity that might exist between the economic complexity of a place and its education attainment. After all, it is plausible to assume that while lower years of schooling might potentially be a constraint to economic complexity, it is also true that in places with lower economic complexity such as Chiapas, people have less incentives to invest in education. While we cannot solve this problem statistically, we will use a statistical process to identify upper and lower ranges for the impact of each variable.

The process has two steps. First, we make a regression between the economic complexity of the municipality where the individual lives (Y) and his education level (X). The residuals of the regression are then used in the Oaxaca/Blinder decomposition as the

exogenous component of complexity, stripped from all its correlation with educational attainment. Thus, we attribute to education all the correlation between complexity and education. In doing so, we obtain a lower bound for the portion of wage differences between Chiapas and the rest of Mexico associated with economic complexity, and an upper bound to the proportion of the gap that is associated with educational attainment.

Then we proceed the other way around, running a similar regression using education as the independent variable and economic complexity as the regressor, and input the residuals in the Oaxaca-Blinder decomposition as the exogenous component of educational attainment. In this second step, we implicitly attribute to economic complexity all of the existing correlation between complexity and educational attainment. Thus, we obtain a lower bound for the contribution of education attainment to explaining income gaps between Chiapas and the rest of Mexico, and an upper limit to the contribution of economic complexity. Table 4 presents the results of the Blinder-Oaxaca Decomposition in four distinct specifications.

The first two columns repeat column (1) of Table 2 and Table 3, containing the Oaxaca-Decomposition in log difference including (column 2) and excluding (column 1) the Economic Complexity Index (ECI). The third column contains the step one described above, and column four the results of step two. Given the significant correlation between education and ECI, we get fairly wide range for the contribution of both variables in explaining the income gap. Whereas the component of the income gap associated with educational attainment goes from 3.4 (column 4) to 19.3 (column 3) percentage points, the component associated with ECI ranges from 18.9 (column 3) to 34.9 (column 4) percentage points.

Table 4. Oaxaca Decomposition: Bounds for Education and Economic Complexity

	Spec. 1	Spec. 2	Spec. 3	Spec. 4
Difference log(income)	0.640	0.640	0.640	0.640
Blinder-Oaxaca				
Characteristics	0.314	0.449	0.449	0.449
Coefficients	0.377	0.289	0.289	0.289
Interactions	-0.050	-0.098	-0.098	-0.098
Characteristics				
Schooling	0.180	0.173	0.193	0.034
Experience	0.002	0.002	0.002	0.002
Female	-0.020	-0.024	-0.024	-0.024
Indigenous Language	0.103	0.052	0.052	0.052
Rural	0.049	0.036	0.036	0.036
ECI		0.209	0.189	0.349
Coefficients				
Schooling	-0.048	-0.062	-0.081	0.004
Experience	0.007	0.061	0.061	0.061
Female	-0.016	-0.010	-0.010	-0.010
Indigenous Language	0.034	0.001	0.001	0.001
Rural	0.018	0.051	0.051	0.051
ECI		0.016	0.082	0.020
Constant	0.317	0.231	0.184	0.161
Interactions				
Schooling	-0.014	-0.018	-0.023	-0.003
Experience	0.001	0.001	0.001	0.001
Female	-0.007	-0.004	-0.004	-0.004
Indigenous Language	-0.023	-0.001	-0.001	-0.001
Rural	-0.007	-0.019	-0.019	-0.019
ECI		-0.056	-0.051	-0.071

Figure 12. Oaxaca-Decomposition: Bounds for Education and Economic Complexity
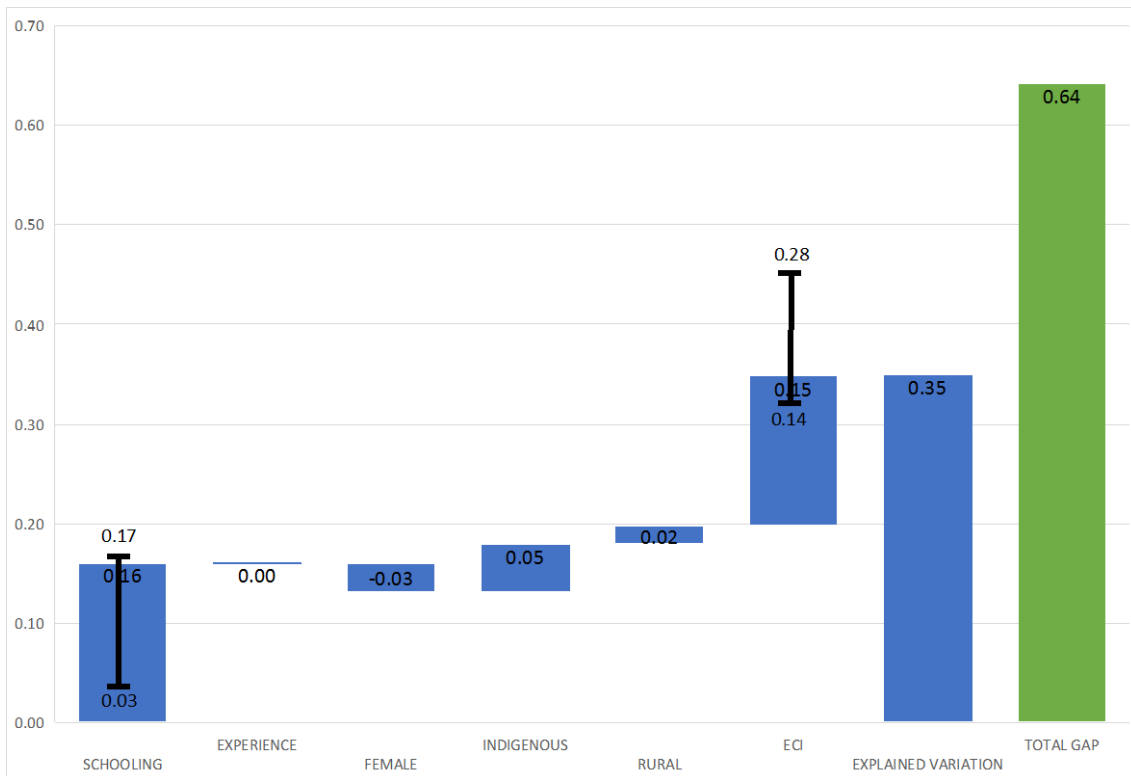
VIII. Conclusions

In this paper we present an original piece of evidence in favor of place-specific explanations of income gaps and poverty. Individual characteristics are only relevant to the extent that place-specific conditions are also favorable. In particular, a productive ecosystem where individual characteristics can be combined with other productive capabilities is indispensable. Infrastructure and credit markets are certainly part of the capabilities required for modern production, but they are not the only ones.

This study analyses novel evidence indicating that Chiapas is not poor because its workers lack education or experience, have an indigenous origin, or live in rural areas. All of these factors have a role, but the most important factor is the lack of a productive ecosystem with modern means of production where workers can learn, combine their capacities and learn new ones, to be more productive.

Modern production systems never made it into Chiapas. The state remains locked into a capability trap, producing goods and services of little complexity that demand little know-how. The lack of complexity in itself acts as a disincentive to acquire further capabilities, as no one wants to study to work in an industry that does not exist. Within such a context, children's education is not regarded as an investment to gain better incomes in the future, but only as an immediate reduction in the household's productive capacity (Pelaez-Herreros, 2012). The state of Chiapas appears to remain trapped in this chicken-and-egg dilemma. Unless this coordination failure is solved, it makes no sense to invest in improving education, as workers from Chiapas will not have an ecosystem that demands those skills and can in turn sustain higher wages. It is pretty much the same that is occurring in road infrastructure, as it makes no sense to improve roads if workers have no means of traveling on them on their way to larger labor markets. In sum, this paper argues that not only place-specific explanations of income gaps matter, but it is the specific production-related eco-system, which is necessary to increase economic complexity, that represents the necessary building piece of place-specific conditions for lower income gaps and poverty.

Can policies influence this process? Given that the central issue that we highlighted is the coordination of actions and policies, strategies explicitly targeting coordination failures at the local level have an especially relevant potential to release such constraints. This may be the case of cluster development policies, that have proved their usefulness in many Latin American countries (Casaburi et al., 2014, Maffioli et al., 2016). Moreover, comprehensive approaches evolving around the systemic notion of value chains (Crespi et al., 2014, Pietrobelli and Staritz, 2017) can also display their potential in these circumstances.

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