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Structural modernization and development traps: An empirical approach

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Structural Modernization and Development Traps. An Empirical Approach*

Alejandro Lavopa and Adam Szirmai†

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Abstract

In this paper we analyse economic development through the lenses of a newly developed index: the structural modernization index. This index combines two dimensions that have been widely invoked as prime drivers of economic development namely, structural change and technological catch up.

For each country, the index calculates the productivity gap with respect to the world frontier in activities that typically represent the modern part of the economy, and weighs this relative productivity by the employment share of those activities in the total labour force. In doing so, it combines a technological dimension (relative productivity) and a structural dimension (the size of the modern sector) thus providing a concise measure of the degree of modernity of an economy.

The index is calculated for a large sample of countries over a long time span. Significant efforts have been made to put together a dataset with international comparable data on value added and employment disaggregated by sectors for 100 countries covering the period 1950-2009.

The estimates are used to explore the relationship between structural modernization and the so-called poverty and middle-income traps. In analysing this relationship, the interactive nature of structural change and technological catch up is stressed. Important insights are obtained regarding the nature of low and middle-income development traps.

Finally, the usefulness of this new index is illustrated when studying the diverse structural trajectories of a set of countries that can be taken as examples of success and failure in the process of economic development.

Keywords: Structural Change; Technological Catching-Up; Poverty Trap; Middle Income Trap.

JEL Classification: O11, O14, O30, O47, O50.

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1. INTRODUCTION

One of the major concerns of the theories of economic development deals with the old question about why some countries manage to succeed in improving standards of living and move progressively closer to the living standards of the richest countries, while other countries get stuck at intermediate phases of development, either at very low levels of income or at middle-income levels. Why do some countries manage to catch up with the world frontier successfully, while others fail to escape from development traps?

Several reasons have been highlighted in the literature to explain these divergent trends, ranging from capital accumulation and technological diffusion to the quality of institutions and geographical conditions. This paper takes the perspective that development failures ultimately reflect the inability of the economic system to realize the transformations that are at the core of the development process. Two transformations stand out in particular: the movement of labour from traditional to modern activities and the reduction of the technological gap with the world frontier in those activities. From this perspective, the success or failure of development should be analysed by looking simultaneously at the evolution of both dimensions over time.

In order to do so, this paper proposes a new index that captures the salient features of these complex and multifaceted dimensions in a parsimonious fashion. On one hand, structural change is studied as the change in the share of labour force employed in modern sectors of the economy. On the other hand, the degree of technological catch up is analysed in terms of changes in labour productivity in the modern sectors relative to labour productivity at the international frontier. The new index combines changes along these two dimensions

The study of changes over time in both dimensions provides a useful device to characterize the structural trajectories followed by different countries in the process of development. Moreover, the comparative analysis of their movements gives an indication of the reasons why some countries fail to achieve long-run sustained development. The cross-country comparisons undertaken in this paper suggest that countries that fall into low or middle-income traps are countries that have failed to achieve a proper transformation along each of these dimensions.

The analysis is carried out on a newly constructed dataset that, combining information from various sources, provides unbalanced data for 100 countries over the period 1950-2009 on employment, labour force and value added in broad sectors of the economy (10 major aggregates of the ISIC rev. 3), with value added converted into a common currency using industry-specific converters. By means of this dataset, internationally comparable measures of sectoral labour productivity and employment shares in total labour force are constructed and used for the analysis of the two dimensions introduced above.

To the best of our knowledge this is the first attempt to look at economic development in such a large sample of countries from this perspective.

The paper is structured as follows. Section 2 provides a brief review of the literature, with special emphasis on recent debates on so-called poverty and middle-income traps. Section 3 describes the main data sources and procedures used to construct the dataset and specifies the main indicators used throughout the paper. It also describes the statistical criteria used to determine whether countries are caught in some kind of development trap. Section 4 introduces the data and prepares the ground for the analysis of development traps in Section 5 and the analysis of the structural trajectories of selected countries in Section 6. Section 7 concludes. A methodological appendix with details regarding the construction of the dataset is included at the end of the paper.

2. LITERATURE REVIEW

2.1. Structural Change and Technological Catch-up

From early contributions in the literature on economic development (Chenery et al., 1986; Chenery and Taylor,1968; Kuznets, 1966 and 1971) to more recent studies on the sources of economic growth and catch up (Hidalgo and Hausmann, 2008; Lin, 2011; McMillan and Rodrik, 2011), a long tradition in economic thought links economic development with the process of transformation and upgrading of productive structures. That is, the progressive shift of the economy from the production of simple goods, typically labour- or natural resource-intensive, to complex and more sophisticated goods, typically capital- and technology-intensive.

From this perspective, economic development can only be understood as a process of transformation. Early development economists have approached this issue by postulating the existence of a dualistic structure in the economies of the developing world. In their view, a distinguishing feature of the less advanced countries is the co-existence of modern economic activities[3], with high productivity using state of art technologies, alongside a set of activities with very low productivity, typically of informal nature and in many cases oriented towards subsistence. The classical models of dual economies *à la* Lewis have formally illustrated this point, stressing a fact that lies at the core of development: at early stages the key to reduce the gap with the advanced world lies in the reallocation of labour from the traditional to the modern part of the economy.[4] In these models, the modern part of the economy has typically been associated with urban industry (more specifically, with the manufacturing sector), as opposed to rural agriculture.

The importance of the economic structure in development has also been emphasized in other strands of economic thought. *Post-Keynesian* authors, mainly working in the *Kaldorian* tradition, have argued that certain sectors (most prominently, manufacturing industries) are better suited to drive economic development. Among others, these sectors would provide special opportunities for technological progress and for the exploitation of static and dynamic economies of scale, and would therefore be more prone to generate rapid growth.[5] The pre-eminence of manufacturing, however, has been recently challenged in view of the rise of the so-called service economy and the ICT technologies. The successful development of services in India and some other countries has resulted in the proposition that other developmental paths, not necessarily driven by manufacturing, are also possible. In

[3] Often the modern sector is referred to as the modern capitalist sector, but this is not necessarily the case. State-owned firms can also be part of the modern sector.

[4] Obligatory references are Lewis (1954), Ranis and Fei (1961), and Sen (1966). For recent reviews on dual models rooted in this tradition see Temple (2005) and Ranis (2012).

[5] See Lavopa and Szirmai (2012) for a recent review on the arguments and the empirical evidence supporting the idea that manufacturing industries constitutes one of the major engines of growth of the economy.

particular, services such as telecommunication, banking, software development, logistics and transport are seen as having a considerable technological dynamism and thus are also regarded as potential engines of economic growth.[6]

Other authors also rooted in the *Kaldorian* tradition have emphasized the fundamental role of economic structure by looking at international trade dynamics, and the requirements of foreign exchange in the process of development. The so-called *Balance-of-Payments-Constrained* models, originating in the seminal contribution of Thirlwall and Dixon (1979), postulate that economic growth is ultimately determined by the relative size of the income elasticities of export and import demand.[7] Therefore, structural shifts towards the production of goods with higher income elasticities would be at the core of successful development.

The importance of economic structure and structural change lies also at the core of the *Evolutionary* and *Schumpeterian* traditions of economic thought. In these cases, however, the emphasis has not been on a single sector as major driver of economic growth, but rather on the role of technological change, regardless of where it takes place. Although certain activities within manufacturing have typically been singled out as the major drivers of technological change, the list of potential drivers is not restricted and includes a wide array of activities, ranging from high-tech agriculture to modern services.[8] The focus here is typically on the distance to the technological frontier, and the capabilities needed to reduce the technological gap, regardless of the specific sector.[9]

In recent years there have been very fruitful efforts to combine these different traditions of economic thinking in simplified formal models of economic development. Castellacci (2002) and León-Ledesma (2002), for example, proposed formal models of catching up in which the *Post-Keynesian* demand factors are merged with *Neo-Schumpeterian* supply elements into a single perspective. Cimoli et al. (2005), Rada (2007) and Ocampo et al. (2009), on the other hand, put forward models in which the dual character of developing economies is analysed in the general context of *Post-Keynesian* demand-led growth models. Finally, Botta (2009) and Cimoli and Porcile (2013) present very interesting attempts to combine the three traditions (*Structuralist*, *Post-Keynesian* and *Evolutionary*) in unified models of catching up and lagging behind between nations.

Following the latter, Lavopa (2014a) proposes a theoretical model to explore the dynamic interactions between structural change and technological upgrading in the process of economic development. The focus of the model is on a "representative" nation of the *South* that is characterized by: i) a dualistic

[6] See Szirmai (2011) and (2015) for a recent review of the sectoral engines of growth debate.

[7] See Thirlwall (2011) for a recent review of these models.

[8] A good example in these lines can be found in Pérez (2010) and her proposal for a catching-up strategy in Latin America based on natural resources based production.

[9] See Fagerberg and Godinho (2005) and Fagerberg et al. (2010) for recent reviews on this literature.

structure (i.e., a large share of labour force working on low-productive-traditional activities that coexists with a small fraction of workers employed in modern activities); ii) a large technological gap in the modern activities with respect to the same activities at the world frontier; and iii) a binding restriction on the external accounts. Under these circumstances, the dynamic behaviour of the analysed economy is ultimately determined by two key variables: the share of labour in the modern sector and the relative level of technological knowledge of the modern sector compared to that of the leading economy. Depending on initial conditions and underlying parameters, the southern economy would be attracted towards different equilibrium points, each of them entailing very different implications for the prospects of long-run development. In the negative cases, the equilibrium points are development or poverty traps.

The empirical approach in this paper has its theoretical roots in these traditions of economic thought, as drawn upon in the model presented in Lavopa (2014a). In particular, we propose an index of structural modernization that tries to combine the aforementioned variables –sector change and technology gap– into a single concise measure of economic development. Hence, by looking at the performance of this index, some of the theoretical outcomes of the model can be compared with the stylized facts that can be observed in empirical reality.

2.2. Development Traps

The study of development has always been related with the idea that there are certain traps into which countries might fall, resulting in failure to catch up with the advanced economies. Starting from Rosentein-Rodan's idea of the big push, most policy recommendations from the *development pioneers* in the 1950s and 1960s were, in a nutshell, strategies to escape the poverty trap. The very concept of a low-income trap has been early formalized by Richard Nelson in his seminal model of capital accumulation and population growth in underdeveloped economies (Nelson, 1956). Many years later it gained renewed interest with the so called *new growth theory* and its emphasis on multiple equilibria.[10] The big push was also revived in the policy recommendations of the Millennium Development Goals (Sachs, 2005). In short, a poverty trap (hereafter, PT) refers to a situation in which there are self-reinforcing mechanisms that cause a country that is initially poor to remain poor. Several empirical contributions have provided evidence for the prominence of this phenomenon.[11]

More recently, the notion of a middle-income trap (hereafter, MIT) has gained increasing attention both in academic and policy circles. First invoked by Gill and Kharas (2007) to stress that certain East Asian economies might not be able to move forward to a high-income status unless they undertake major shifts in their economic strategies, the concept has become increasingly popular, especially in

[10] See Azariadis and Stachurski (2005) for a recent review of this kind of models.

[11] See, for example, Berthélemy (2006), Bloom et al. (2003), Guillaumont (2009), and Quah (1996).

Latin America and Developing Asia. Some theoretical arguments support this perspective. From the perspective of international specialization, middle-income economies face the challenge of moving from competitiveness in low-wage activities and routinized tasks to competitiveness in knowledge based production using cutting-edge technological innovations (Eeckhout and Jovanovic, 2012; Garrett, 2004; Jankowska et al., 2012; Lee, 2013). Failure to implement policies of transformation would strand middle-income economies between low-wage manufacturers and high-wage innovators. Their wages would be too high to compete with the low-wage competitors, while their technological capabilities would be too weak to compete with high-wage innovators. As Ohno (2009) clearly puts it, middle income economies remain trapped in that income category when they are unable to break through the "glass ceiling" that separates the stage of industrial development where production remains under foreign guidance and the stage in which skills and knowledge are already internalize and locals can replace foreigners in all areas of production, including management, technology, design, factor operation, logistic, quality control and marketing.

Lee (2013) develops this line of argument further and suggests that the emergence of middle income traps is closely related to the success or failure of middle income countries to build up the necessary technological capabilities. In his view, middle income countries that fail to upgrade and diversify their economy towards sectors with short-cycle technologies are more likely to fall in this sort of traps. Short cycle technologies where innovation is faster and existing knowledge rapidly becomes obsolete offer the best chances of outcompeting high-tech incumbent firms and countries. The transition from middle to high incomes involves a technological based specialization in sectors where there is a frequent emergence of new technologies which are not yet dominated by the advanced economies. Failure to achieve such specialization would doom these economies to remain in lower-wage activities which have few prospects for long-term success.

Jankowska et al. (2012) explore a related explanation for the emergence of middle income traps. In their view, the limited income convergence of these countries is explained (at least partially) by their reduced capacity to engage structural transformations conducive to higher productivity. This conclusion is grounded on a detailed analysis of the transformations that took place in the export structures of successful Asian economies as compared to the Latin American countries caught in the middle income trap. To analyse these transformations the authors investigate a series of measures based on the so-called Product Space approach (Hausmann et al., 2007; Hidalgo et al., 2007): export diversification, export upgrading, export profile connectivity and degree of export clustering. The general conclusion is that while Asian economies managed to significantly improve their export profile, the Latin American economies failed to do so.

Though its theoretical foundations are still a matter for debate, many attempts have been made to empirically analyse the existence and prevalence of the MIT. Woo (2012) proposes a *catching up*

index (CUI) based on the relative income with respect to the world leading economy (the US), and defines the MIT as a situation in which the value of the index remains in a middle band for a long period of time.[12] According to his estimates, five Latin American countries (Argentina, Brazil, Chile, Mexico and Venezuela) are clearly caught in the MIT, while Malaysia is also "muddling" along in the trap. Using a similar perspective, Robertson and Ye (2013) put forth an approach based on time series analysis. In their view, a country would be caught in the MIT if the long-term forecast of its per capita income relative to the US is time invariant and within a middle-income band.[13] In total, they identify 19 countries in the MIT for the year 2007. Felipe (2012) takes a different perspective. Instead of looking at the relative income with respect to the US, he defines income thresholds in constant PPP dollars and extends the World Bank's classification of countries by income levels to the period 1950-2010.[14] Then he calculates the median number of years that the countries of his sample have taken to "graduate" from the lower middle-income category to the upper middle-income category and from the upper middle-income category to the high-income category. Using these median numbers as cut-offs, he defines two traps: the lower-middle income trap (LMIT) and the upper-middle income trap (UMIT). In the first trap he includes all countries that, by 2010, have been classified as lower middle-income countries for longer than the median number of years needed by the group that graduated from this category. Similarly, in the second trap he includes all countries that, by 2010, have been classified as upper-middle income countries for longer that the median number of years needed by the group of countries that graduated from this category to the high-income category. In total, he identifies 35 countries caught in the middle income trap, of which 30 are in the lower-middle income trap and 5 in the upper-middle income trap. In section 3.2 of this paper we use an elaboration of Felipe's approach to identify countries in the lower-middle and upper-middle income traps.

[12] In his analysis, the band is defined as a CUI that lies between 20% and 55%.

[13] In their analysis, the band is defined as a relative per capita income lying between 8% and 36% of the one of the US.

[14] The World Bank distinguishes four income categories: low, lower-middle, upper-middle and high incomes. These categories are defined according to certain thresholds imputed on the per capita GNI calculated using the *Atlas* method. Section 3.2 describes this method in more detail.

3. EMPIRICAL APPROACH

3.1. An index of Structural Modernization

Following the theoretical discussion in the previous section, we examine two interrelated dimensions that are at the core of the development process: structural change and technological catch up. In a purely theoretical exercise, the first dimension would be captured by the share of labour population working in the modern part of the economy. The technological dimension, in turn, would be captured by the relative level of technological knowledge of the modern part of the economy compared to that of the world frontier. Yet, to empirically capture these dimensions we need operational definitions that allow for analysis with the available data. Hence, part of the theoretical soundness needs to be sacrificed in order to have a measurable variable based on real data widely available through time and across countries.

The first dimension is relatively easy to operationalize. There are long datasets covering employment characteristics in almost all countries (of course, with different degrees of reliability, but typically good enough to get a stylized picture). The main challenge here lies in determining what exactly should be included as the modern part of the economy. This is especially problematic due to the lack of highly disaggregated data by sector for long periods in developing countries. For this reason, our definition of the modern sector will be restricted to an aggregate of broad sectors. In particular, the comparable data at hand (to be described in more detail in Section 3.3) only allows for a distinction of 10 major sectors as detailed in the following table:

Table 1. *Sectoral Disaggregation and Definition of Modern Market Activities (MMA)*

ISIC rev 3	Sector
AtB	*Agriculture, Hunting, Forestry and Fishing*
C	*Mining and Quarrying*
D	*Manufacturing*
E	*Electricity, Gas and Water*
F	*Construction*
GtH	*Wholesale and Retail Trade and Restaurants and Hotels*
I	*Transport, Storage and Communication*
JtK	*Financing, Insurance, Real Estate and Business Services*
70	*Real Estates*
LtQ	*Community, Social and Personal Services*
CtF+I+JtK-70	Modern Market Activities (MMA)
AtB, GtH, 70, LtQ	Non-Modern Activities (NMA)

Ideally each sector of the economy should be divided between its modern and traditional components. Take the case, for example, of agriculture. It is clear that small scale subsistence agriculture should be included in the traditional sector. Modern and highly mechanized agricultural activities oriented towards exports, instead, should be considered as part of the modern economy. By the same token, extremely profitable retailers (such as *IKEA* or *Wal-Mart*) should be considered part of the modern sector as opposed to informal street vendors (both included in Sector *GtH*).[15] The availability of reliable data allowing for such distinctions, however, would make the analysis only feasible for a few advanced economies. As a *second best* solution, our approach identifies those sectors that are predominantly composed of what can typically be considered as modern activities.[16] Following the literature on this topic (and in particular that related to the different engines of economic growth) the salient candidates are: Industry (that is, Mining, Manufacturing, Utilities and Construction) and international tradable services (that is, Transport and Telecommunications and Financial and Professional Services[17]). These sectors can be regarded as modern both from a static and dynamic perspective. On the one hand, they typically have higher levels of productivity than the rest of the economy (static advantage). On the other hand, and perhaps more fundamentally, they also present a higher potential for technological upgrading and productivity gains. Henceforth, these activities will be grouped together under the label Modern Market Activities (MMA), and will be associated with the modern part of the economy. The other sectors, notably including government, which is part of community, social and personal sectors (LtQ) are categorized as non-Modern Activities. Our key variable to analyse structural change will be, therefore, the number of workers in the modern sector as percentage of total labour force and will be denoted with the Greek letter *Lambda*. That is:

$$\lambda_t^i = \frac{N_{M,t}^i}{L_{T,t}^i} \tag{1}$$

Where N_M stands for employment in MMA, L_T for the total labour force, the subscript *t* represents the time and the superscript *i* the country.

[15] A detailed discussion on the heterogeneity of this sector in the context of developing countries can be found in de Vries (2010).

[16] In this classification, the 'traditional' sector not only includes activities such as traditional small holder agriculture or informal sector services, but also productivity resistant sectors such as government or restaurants. These are not strictly 'traditional', but they are included here because they do not have the potential to drive aggregate growth through their productivity dynamics.

[17] Professional Services are actually a component of the sector *K* in the ISIC classification. In order to calculate this component, we subtract from this sector the industry number 70 (Real Estates). When building the data we only considered those countries for which this distinction could be made at least in the GDP figures. If this distinction was not possible in the employment data, we included as MMA the whole sector *K*. This, however, should not introduce an important bias, since employment in Real Estates (as opposed to Value Added) is typically negligible.

It is important to stress the fact that the denominator is defined in terms of the total labour force, and thus also includes the unemployed population. The rationale behind this is that workers that do not find any job opportunity in the labour market should also be considered as part of the "traditional" or unproductive sector.[18]

The second dimension (technological knowledge) is much more difficult to capture, since it refers to a complex concept that cannot be directly measured. Following the standard literature on this issue, this dimension will be proxied by the relative labour productivity of the domestic modern sector compared to the same sector in the world leading economy.[19] In this sense, we assume that labour productivity indirectly reflects the level of technological knowledge embedded in the production of those goods that are produced within the MMA aggregate. Hence, our key variable to analyse the technological dimension is the relative labour productivity of the modern activities with respect to the world frontier and will be denoted with the Greek letter *Rho*. That is:

$$\rho_t^i = \frac{P_{M,t}^i}{P_{M,t}^f} \tag{2}$$

Where P_M stands for the labour productivity in modern activities and the superscript *f* stands for the *frontier* or leading economy.

The use of this proxy, however, is not without difficulties. First and foremost, the aggregate to be compared should be composed by exactly the same set of activities in the domestic and the leading economy. Therefore, especial care should be taken when building the dataset in order to work with comparable sectoral aggregates. In addition, the corresponding measures of labour productivity should be valued in a currency that is internationally comparable. Since the goal is to compare specific parts of the economy, from the production side, it is important to use sector-specific conversion ratios. In order to address this second problem, the productivity measures are first calculated at sectoral level in local currency units (LCU) and then converted into an international currency using the multilateral industry of origin PPP convertors published in Inklaar and Timmer (2012).[20] The resulting figures at PPP dollars are then aggregated into the MMA sectoral aggregate to estimate the corresponding index of relative labour productivity.

[18] See McMillan and Rodrik (2011) for an enlightening discussion on this issue. Note that our non-modern sector is broader than the 'traditional' sector in older dual economy models.

[19] A detailed discussion on the use of productivity as a proxy for technological capabilities can be found in Szirmai (2015), chapter 4.

[20] In fact, these are expenditure PPP convertors that have been adjusted to match as closer as possible with industry of origin PPPs. In particular, trade and market margins have been peeled off and specific corrections have been done to account for the relative prices in intermediate (domestic and imported) goods.

For every country of our sample we start by estimating the value added per worker (at current local currency units) in each sector that is part of the MMA aggregate, for the benchmark year 2005:

$$P^i_{j,lcu} = \frac{Y^i_{j,lcu}}{N^i_j} \qquad j=C, D, E, F, I, JtK\text{-}70 \qquad (3)$$

where, *Y* stands for the sectoral value added and the subscript *j* identifies each of the six sectors that compose the MMA aggregate (as detailed in Table 1). The subscripts *lcu* in *P* and *Y* indicate that these measures are expressed in local currency units.

Then we convert these figures into international dollars using the sector-specific convertors of each country (PPP^i_j):

$$P^i_j = \frac{P^i_{j,lcu}}{PPP^i_j} \qquad j=C, D, E, F, I, JtK\text{-}70 \qquad (4)$$

These figures at 2005 international dollars are then extrapolated forwards and backwards using the corresponding growth rates of sectoral labour productivity in order to cover as many years as possible within the period 1950-2009.

Once the sectoral productivities have been calculated for each country/year, we estimate our measures of labour productivity in the modern market activities, simply as a weighted sum, using the sectoral shares in total MMA employment as weights:

$$P^i_{M,t} = \sum_j s^i_{j,t} P^i_{j,t} \qquad j=C, D, E, F, I, J, K\text{-}70 \qquad (5)$$

where $s^i_{j,t}$ stands for the share of employment of sector *j* in total employment of MMA in country *i* for the year *t*.

Finally, to compute our index of relative productivity in MMA, we need to estimate the world technological frontier at every point of time. This is done by identifying the country that has the highest $P^i_{M,t}$ in each year:

$$P^f_{M,t} = max\left(P^i_{M,t}\right) \qquad (6)$$

Dividing the domestic productivity in modern activities by the frontier value yields the relative productivity of each country in each year as specified in equation (2).

The fact that we compute the frontier in this way entails that the leading economy is not necessarily always the same one. Moreover, the leader might not have the highest productivity in every single

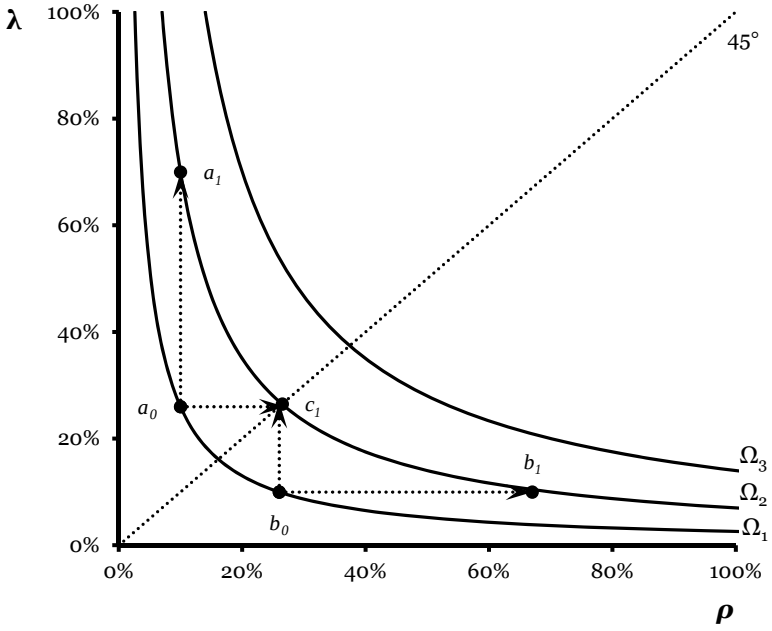
sector that composes the MMA aggregate. Since this aggregate also includes heterogeneous activities, the leader might have the highest productivity not because it represents the frontier in every sector, but because its sectoral composition is heavily oriented towards the sectors with the highest productivity in absolute terms (in which it should represent the frontier or be close to it). In this paper, we do not distinguish these effects (structural composition as opposed to sector-specific catching up), since we only look at the aggregate of modern market activities. This will be done in a subsequent paper (Lavopa, 2014b)

Using these two indicators we derive our measure of structural modernization by simple multiplication:

$$\Omega_{\mathrm{t}}^{\mathrm{i}} = \lambda_t^i * \rho_t^i \qquad (7)$$

The index of structural modernization (Ω) proposed in this paper is thus the relative productivity of modern activities weighted by their share in total labour force. Interestingly, the proposed index not only combines the dimensions previously described, but also assigns different degrees of importance in the final value depending on their relative values. Since the components of the index are two positive values that can only range between 0 and 1, the resulting index is convex to the origin. That is, it will always reward balanced situations (e.g. situations in which the relative size of the modern activities and their technological gap are not very different) and penalize situations in which only one of this dimensions is large while the other is very small. Therefore, a country that either has a very large modern sector that is completely behind in terms of technological sophistication, or an extremely productive modern sector that accounts for only a minor part of the economy will typically rank lower according to this index than an economy that has a medium-size MMA with a relatively large (but not extreme) technology gap. The following figure illustrates this feature and introduces the main graphical tools that will be used throughout this paper:

Figure 1. *Structural Modernization Landscape: Level Curves and Structural Trajectories*



The figure shows what we will from now on refer to as the Structural Modernization Landscape. Each point in the landscape gives a certain combination of values for the two dimensions of our structural modernization index. That is, a value for the share of modern activities in total labour force (λ) and a value for the relative labour productivity of these activities with respect to the leading economy (ρ). The different curves in the landscape ($\Omega_1 < \Omega_2 < \Omega_3$) give different combinations of λ and ρ for which the structural modernization index has the same value. In the landscape we have also drawn five points, indicating different positions in which an economy could be at different point of times. The movement from one point to another (from a_0 to a_1, for example) will hereafter be referred to as a *structural trajectory.* The trajectory indicates the main structural changes in a given economy between two (or more) points in time. Finally, the landscape is divided in two major areas by the 45 degree line. Given the convexity of the index, on the left-hand side of the diagonal increases in ρ are relatively more important than increases in λ and the other way around on the right-hand side. This is illustrated in a comparison of structural trajectories $(a_0; a_1)$ and $(a_0; c_1)$. Starting from a_0 the change needed in λ to increase the structural modernization index from Ω_1 to Ω_2 is much larger (in percentage points) than the change needed in ρ. The opposite holds on the right side of the 45 degree line, as the comparison between trajectories $(b_0; b_1)$ and $(b_0; c_1)$ illustrates. The position of a country at either side of the diagonal provides a rough indication of the dimension that it needs to improve most urgently to increase its level of structural modernization. However, percentage changes can be

misleading.[21] Therefore, the position in the landscape will be taken as an indicative (but not conclusive) element in what follows. As we will show in Sections 5 and 6, this graphical tool is useful to characterize the development path followed by different economies in international comparisons and across time.

3.2. Defining the Development Traps

One goal of this paper is to study the structural trajectories (in the terms described above) of those countries that are caught in a certain development trap (either a poverty trap or a middle-income trap). Therefore, an operational definition of those traps and an analytical metric to classify countries in low, middle and high incomes is needed. From the various perspectives previously reviewed, this paper builds on the one developed by Felipe (2012).

Our metric to classify countries by income category heavily relies on the classification used by the World Bank. For more than three decades, this organization has been publishing a country classification by income category that encompasses four major categories: low, lower-middle, upper-middle and high incomes. These categories are defined in terms of the per capita gross national income (GNI) of each country estimated using the so-called *Atlas* method. The income categories have been historically defined based on the relationship that exists between GDP per capita and other summary variables of well-being such as poverty incidence or infant mortality. The original thresholds have been then updated every year to incorporate the effects of international inflation and therefore they remain constant in real terms over time (World Bank, 2014).

Unfortunately, the threshold levels of GDP per capita used by the World Bank are only published since 1987. In order to cover a longer time span (in particular, to extend the analysis back to 1950), a procedure is needed to calculate the income thresholds on the basis of an international comparable measure available for the whole period. Our income measure is the GNI per capita at constant PPP dollars of 2005 from the World Bank *World Development Indicators*.[22] Like Felipe (2012) we define the PPP income thresholds in 2005 constant PPP dollars in such a manner as to get the maximum correspondence between the country classifications based on our method and the country classifications based on the original World Bank methods for the period 1987-2013. This is done ad-hoc, experimenting different threshold levels and checking the number of coincidences obtained along that period. The thresholds identified using this procedure yield a 90% of coincidence in the classification of countries as compared to the original classification published by the World Bank. These thresholds are subsequently used for all years of our period (1950-2013).

[21] Increasing the share of the modern sector in total labour force by 10 percentage points, for example, could actually be more difficult than reducing the technological gap by 20 percentage points.

[22] This dataset starts in 1960. Therefore, three additional sources have been used to expand its coverage both along time and across countries. See Appendix 10.1 for the details.

The identified thresholds are the following (in 2005 PPP dollars): low income (less than 2.250 PPP dollars), lower-middle income (between 2.250 and 7.249 PPP dollars), upper-middle income (between 7.250 and 14.999 PPP dollars) and high income (15.000 PPP dollars and above). Next, by means of these thresholds, we determine the yearly income category of each country between 1950 and 2013. In many cases, the income category varies from year to year due to cyclical movements in per capita GNI. To avoid these fluctuations in the yearly income classification, we eliminate isolated downturns[23] and only *upgrade* the income classification of a country if it does not fall back into a lower category in the remaining years of the period 1950-2013. According to this rule, a country can only *graduate* once from a given income category to the one above it during the period studied.[24] Therefore it is possible to pinpoint the exact year in which this change takes place. More important for our procedure, it is possible to unambiguously calculate the number of years that each country of our sample has been classified as low, lower-middle, upper-middle and/or high income economy during the period.

Once this is calculated we can develop an operational definition of middle-income traps. Our approach is based on Felipe (2012), but with some modifications. As stated in Section 2.2, Felipe uses the median number of years needed to graduate for the countries that actually graduated from one category to another within the period of analysis, as a benchmark. Any country that is classified as a middle-income country for more than the median number of years, is considered to be caught in a middle-income trap. One disadvantage of this procedure is that it might overestimate the number of countries really caught in the MIT. An economy that takes a few more years than the median to graduate to a higher income category can hardly be considered trapped. To minimize this potential misclassification, we use a more conservative approach: instead of using the median duration of graduation, we take the average number of years needed to graduate by the upper quartile of the distribution of countries that have graduated to a higher income category between 1950 and 2013. We only consider a country as trapped if it has been in a given category more years than the *slowest* 25% of countries that managed to make the transition during the period under analysis.

A second adjustment to the Felipe procedures deals with the countries that have transited to their current income category within a time frame that is shorter than the corresponding threshold. These countries would be classified as not trapped per definition. However, in reality these countries might have also fallen into a middle-income trap. Whether this is the case depends on the speed of economic growth they will show in the years to come. If they do not grow fast enough, they will be also captured in the MIT. In order to incorporate these cases, we project the number of years that these countries

[23] These are defined as drops in a category for only one or two years in a window of 5 years.

[24] It is important to notice that by using this procedure we are excluding the possibility of a country following a falling behind trajectory. That is, a country first upgrading to a higher income category and later slipping back to a lower income category for a long period of time. Even though this only happens rarely (in our sample it can be observed especially in some transition economies after the fall of the Soviet Union), we will try to include this type of trajectories as well in future work.

would need to graduate from their current income category to the next one under the assumption that they will maintain the growth rate of the last two decades.[25] If the estimated number of years in that a country is projected to stay in the same income category exceeds the benchmark duration, this country will also be classified as being caught in the MIT. Since the classification is based on a projection, in our analytical sections we will carefully distinguish both situations (i.e., the countries actually trapped and those that might be potentially trapped according to our projections of growth rates). These procedures only apply to middle-income traps. We distinguish a lower-middle income trap (a country takes too long to graduate from the lower middle income to upper middle income category) and an upper middle-income trap (the country takes too long to graduate from the upper middle-income category to the high income category).

Finally, an operational definition is also needed for the poverty trap –countries that are trapped in the low-income category (Felipe's procedures only apply to middle-income traps). In this case, we had to use a slightly different procedure than for the countries in the middle-income trap. Since there is no income category below the low-income category, we do not know when a country entered the low-income category. Therefore, we can also not calculate how long it takes for a country to graduate to the lower-middle-income category. However, assuming that growth rates of the past two decades will be maintained, we can project the number of years that the current poor countries will need to surpass this income category. Having estimated the number of years to graduation for all the low-income countries of our sample, we can again examine the corresponding distribution and establish a threshold to distinguish between low-income countries in the way to becoming middle income economies and low-income countries actually trapped in poverty. Our criterion here is to include in the Poverty Trap all countries located in the upper quartile of this distribution.[26]

Summing up, a country is considered to be in a lower-middle income trap (LMIT) if, in 2013, it has been in that category for more years than the average needed by the *slowest* countries that *graduated* from that category between 1950 and 2013. By the same token, a country is considered to be in a upper-middle income trap (UMIT) if in 2013 it was already categorized as upper-middle income country for more years than the average of the *slowest* countries that managed to *graduate* to high incomes between 1950 and 2013. A country is *projected* to be in a LMIT if the estimated number of years that it will be in that category (assuming the same growth rate of the last two decades) is larger than the benchmark previously defined. Similarly, a country is projected to be in the UMIT if the estimated number of years that it will be in that category (once more, assuming the same growth rate

[25] That is, the estimated number of years is calculated taking the average annual growth rate of per capita GNI observed between 1993 and 2013. The projections have also been done using the average growth rates of other periods (1998-2008, 2003-2013 and 2010-2013) and the results do not change significantly.

[26] Other measures have also been explored. Using the median or the average of the distribution plus half standard deviation also yields similar results.

of the last two decades) is larger than the corresponding benchmark. Finally, a country is considered to be in a poverty trap (PT) if the projected number of years needed to surpass the low-income category lies at the upper quartile of the distribution of projected years needed to graduate for all the low-income countries of our sample.

3.3. The Dataset

One of the contributions of this paper is the construction of a very large data set with international comparable data on employment and value added by sector (10 sectors previously defined) and unemployment. These are the variables required for the construction of the modernization index described above.

In short, the dataset contains information for 100 countries over the period 1950-2009. The coverage for each individual country, however, varies significantly in accordance to data availability. On average, the number of years covered is 30. In order to minimize potential noise in the estimates, all variables have been calculated as averages over five-year periods, starting in 1950 and ending in 2009. Thus we have a total of twelve periods, covering the last six decades.

This dataset has been constructed using a wide array of sources. The approach, in all cases, was to build a benchmark estimate for the year 2005 using the best available information and then extrapolate these estimates to the other years using indices of growth at constant prices (in the case of value added) or employment, at sectoral level. The benchmark estimates for 2005 were first calculated in current LCU and then converted (at sectoral level) into PPP international dollars using the sector-specific ratios estimated by Inklaar and Timmer (2012).

For 42 countries for which the data was available, these estimates have been done at a larger disaggregation of 35-industries. For the remaining countries, sector specific conversion factors at the 10 broad sectors previously detailed were used.

Due to international comparability, information quality and data disaggregation, the following sources have been given priority when constructing the figures on sectoral value added and employment (in this order)[27]:

1) World Input-Output Database (WIOD)[28]
2) Asia, EU and World KLEMS Databases (KLEMS)[29]

[27] For certain countries these sources have been complemented with information directly published by the National Statistics Institute (NSI) or other contributions that have specifically dealt with this issue. NSI data has been used for Argentina, Chile, and Vietnam. In the cases of Brazil, China and India we have also used the dataset put forth in de Vries et al. (2012). Finally, data for Turkey was complemented with the dataset built by McMillan and Rodrik (2011).

[28] Available at www.wiod.org. See Timmer (ed) (2012) for details.

[29] Available at asiaklems.net, euklems.net and worldklems.net respectively.

3) OECD Structural Analysis Database (STAN)[30]

4) Groningen Growth and Development Centre, 10 Sector Database (GGDC10s)[31]

5) Asian Productivity Organization Database (APO)[32]

Using these sources it is possible to cover a total of 74 countries (35 advanced and 39 developing economies). Given the overrepresentation of advanced economies, several additional sources have been used to increase the number of developing economies included in the sample:

1) Asian Development Bank Key Indicators for Asia and the Pacific Database (KIAP)[33]

2) EUROSTAT Database (Modules for non-EU countries)[34]

3) United Nations Economic Commission for Latin America and the Caribbean Statistical Database (CEPALSTAT)[35]

4) United Nations Economic Commission for Africa: UNECA (2005)

5) United Nations Statistical Division, National Accounts Database[36]

6) International Labour Organization, Key Indicators of the Labour Market Database (KILM8)[37]

Using these additional sources we managed to build a consistent and international comparable dataset that encompasses 100 countries (36 advanced and 64 developing countries).[38]

As we have already stressed before, our index to capture structural change is based on the number of workers in modern market activities as percentage of total labour force. This means that the denominator of our index includes not only employed but also unemployed population. Hence, figures for the unemployed population are also needed. Since the most widely available indicator in this regard is the unemployment rate, our strategy to estimate these figures is to make use of this rate and

[30] Available at stats.oecd.org

[31] Available at www.ggdc.net. See Timmer et al. (2014) for details.

[32] Available at www.apo-tokyo.org/about/measurement.html

[33] Available at www.adb.org/data/statistics

[34] Available at epp.eurostat.ec.europa.euu. In particular, we used the data referred to these subsets of countries: *Southern European Neighbourhood Policy countries (MED)*, *Candidate countries and potential candidates (CPC)*, and *Eastern European Neighbourhood Policy countries (ENP).*

[35] Available at www.estadisticas.cepal.org

[36] Available at unstats.un.org

[37] Available at www.ilo.org/kilm

[38] In the Appendix we detail the specific sources and procedures used for each country/period and the final coverage for that country.

the total employment figures calculated before. Note that the unemployment rate is defined as the share of unemployed population over total labour force, that is,

$$u_t^i = \frac{U_{T,t}^i}{L_{T,t}^i} \tag{8}$$

where $U_{T,t}^i$ stands for the total number of unemployed people in country *i*, in year *t*. Then by simple algebraic manipulation we can obtain an expression for the unemployed population that depends on the variables that we actually have[39]:

$$U_{T,t}^i = \frac{u_t^i}{1 - u_t^i} N_{T,t}^i \tag{9}$$

where N_T stands for the total number of employed people.

In order to estimate the unemployed population, therefore, significant efforts were devoted to construct long series of unemployment rates that were comparable both across countries and over time. This was not an easy task and in many cases the results should be interpreted with some caution. Still, the trends seem to be in line with historical records. In building these series, we also made use of a wide array of sources (see appendix 10.3 for the details).

Unfortunately, in many countries the constructed series of unemployment rates cover a shorter period than our estimates for sectoral employment and value added. Therefore, for the country/years in which data on employment was available but no data on the unemployment rate could be gathered (typically developing countries in the 1960s and 1970s), the unemployed population was back cast using the growth rates of total employment, under the assumption that the unemployment rates have not changed significantly during these years.

[39] $\frac{U_{T,t}^i}{L_{T,t}^i} = \frac{U_{T,t}^i}{N_{T,t}^i + U_{T,t}^i} \Rightarrow u_t^i\left(N_{T,t}^i + U_{T,t}^i\right) = U_{T,t}^i \Rightarrow u_t^i N_{T,t}^i = U_{T,t}^i - u_t^i U_{T,t}^i \Rightarrow u_t^i N_{T,t}^i = \left(1 - u_t^i\right) U_{T,t}^i \Rightarrow U_{T,t}^i = \frac{u_t^i}{1-u_t^i} N_{T,t}^i$

4. STRUCTURAL CHANGE AND DEVELOPMENT

Structural change has been typically analysed as the changes that take place in the sectoral structure of employment or output as countries develop. Following the classical models of dual-economy, in this paper we take the perspective that employment is the key variable to look at. As we have previously stated, this emphasis comes from the understanding that the crux of development lies on the capacity of the economic system to productively absorb an increasing number of its labour force in the modern sector.

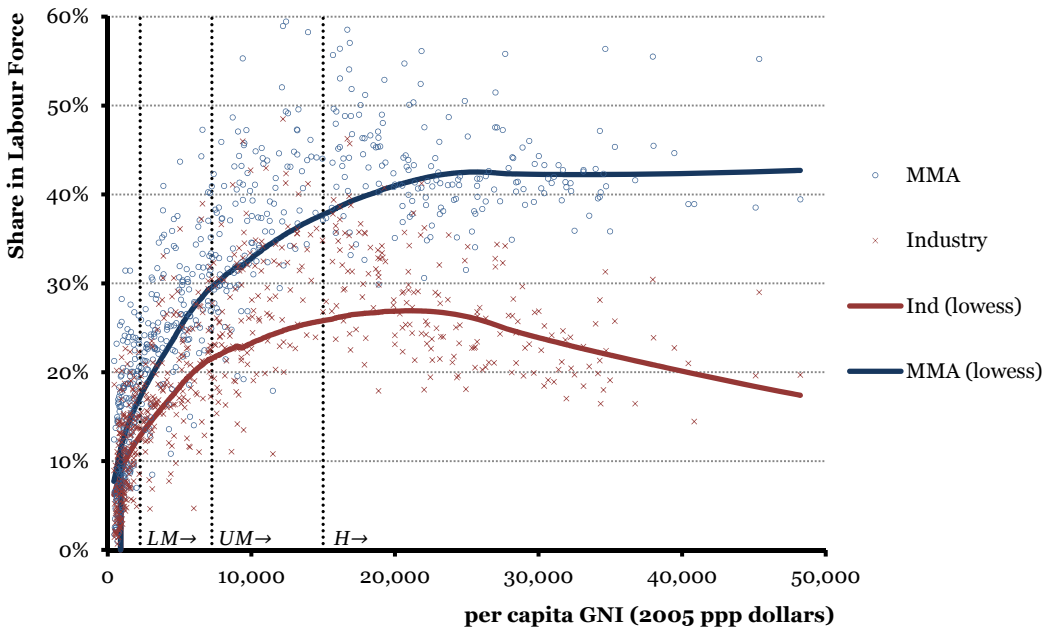
The emphasis in the development literature has been typically placed on industry (or more restrictively, on manufacturing). In order to also incorporate modern services we rather focus on the aggregate of modern market activities. Figure 2 compares the evolution of both shares as countries get richer[40]. It presents the relationship between the level of per-capita GNI at constant 2005 PPP dollars (x-axis) and the corresponding share of industry and MMA on total labour force (y-axis). Each dot in the figure shows the average values of one country over a five-year period between 1950 and 2009. Three vertical lines crossing the horizontal axis divide the figure in the income categories previously defined: low (*L*), lower-middle (*LM*), upper-middle (*UM*) and high (*H*) incomes. In all figures presented in this section we also include the fitted curves obtained by locally weighted regressions (*lowess*)[41,42]. These curves facilitate the visualization of the main patterns that can be derived from the data, without imposing any prior specification on the nature of the relationship.

[40] All figures presented in this section exclude the United States (because it is taken as the benchmark for comparison in the productivity measures) and two outliers: Iran and Venezuela. These outliers presented extremely high levels of relative productivity in MMA exclusively due to their abundance of oil.

[41] *Lowess* stands for "locally weighted scatterplot smoothing" and is a non-parametric method to fit a smooth curve. In short, it fits polynomial regressions to localized subsets of the data and joins them together. By doing so, it gives smaller weights to the observations that are more distant from each subset. Therefore, the shape of the fitted curve at high (low) values of the explanatory variables is not affected by the points corresponding to low (high) values. See Cleveland (1979) for the details and Carmignani and Mandeville (2010) and Eichengreen and Gupta (2011) for recent applications of this method in the analysis of structural change.

[42] All fitted curves have been calculated using Stata 13.0 with the default options (bandwidth of 0.8 and Tricube Weighting Scheme). Other bandwidths and weighted schemes were also explored and gave similar results.

Figure 2. *Share of Labour Force in Modern Market Activities (MMA) and Industry by levels of per capita Gross National Income (GNI), at constant PPP dollars of 2005. Five year averages between 1950 and 2009 for 97 countries.*



For industry, the figure clearly illustrates the well-documented inverted-U shape as a country develops. The fitted curve for the share of the industrial labour force grows steadily at initial and medium levels of incomes, reaches a maximum at about 21.000 dollars and then starts declining. Perhaps more interestingly, the figure suggests a different pattern in the MMA aggregate. At initial and medium levels of incomes, it also grows steadily but at a faster pace, pointing to the increasing importance of non-industrial modern activities. Then, it gradually decelerates and at about 22.000 dollars it reaches a plateau and stays at a relatively steady level. Hence, in clear contrast with Industry, the aggregate of modern activities does not show any clear turning point. According to the fitted curve, this steady level would be around 42% of total labour force.

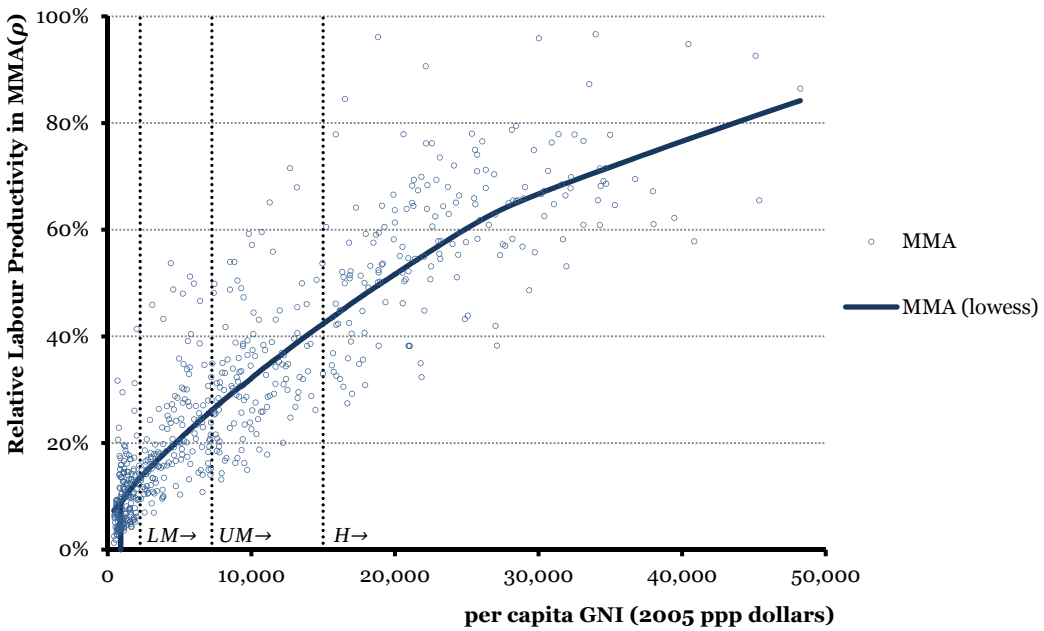
This contrasting behaviour is explained by the dynamics of the modern services, whose share continues to grow even at very high levels of income, partially (or totally, depending on the case) counterbalancing the decline in industry.

The fact that beyond a certain point the share of modern activities in total labour force bends and becomes flatter indicates that above a certain level of income, structural composition no longer varies with income. Once a country has graduated to the high-income category, further increases in the share of the modern sector are no longer correlated with income. Other factors seem to become more important. The figure also shows that almost no country achieves high income levels without having a modern sector of at least 35 to 40% of the labour force. However, a large modern sector is not

sufficient for achieving high incomes. There are many country observations in middle-income ranges of income with a labour share in modern activities larger than 40%.

As we have previously stated an important part of the story still missing in Figure 2, is the size of the technological gap. Therefore, it is important to look simultaneously at how far each economy is from the world technological frontier in the production of these goods (that is, once the traditional and non-market sectors are excluded). As stated in Section 3.1, our proxy variable to analyze this phenomenon is the relative labour productivity with respect to the world frontier that, according to our estimates, is usually the United States.[43] The following picture presents the relationship between this variable and the level of per capita income:

Figure 3. *Relative Labour Productivity (**ρ**) in Modern Market Activities (MMA) by levels of per capita Gross National Income (GNI), at constant PPP dollars of 2005. Five year averages between 1950 and 2009 for 97 countries.*

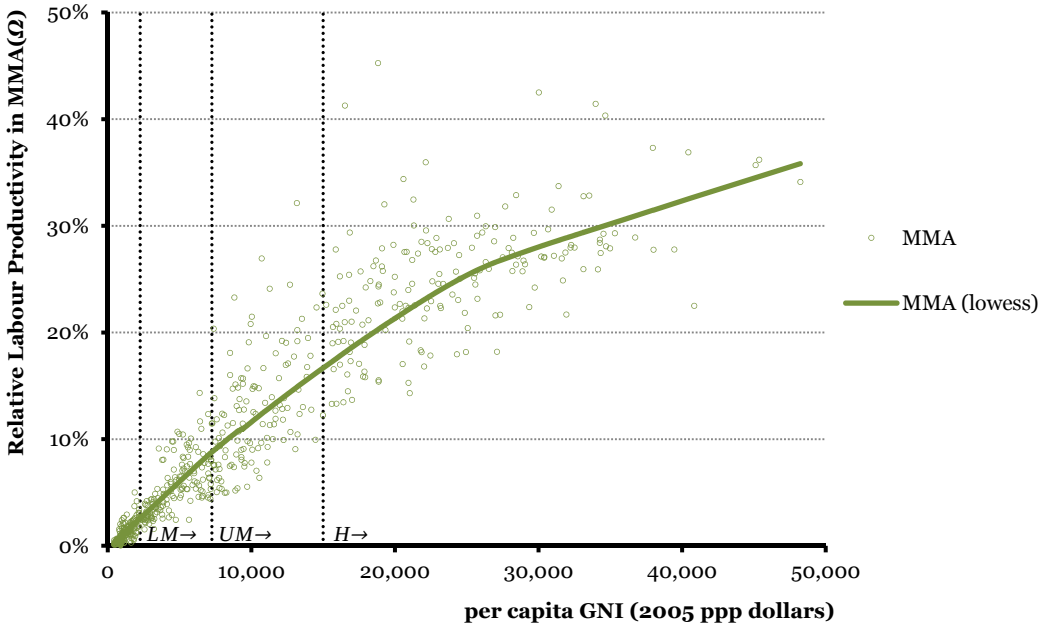


Not surprisingly, Figure 3 presents evidence of a very strong positive correlation between our proxy of relative technological knowledge in modern activities and the level of incomes. Moreover, this remains positive even at upper middle and high levels of income, providing further evidence on the fundamental role that technological catching up plays once the low and lower-middle income ranges are surpassed.

[43] This country is found to be the world leader in terms of labour productivity in MMA, for almost all year between 1950 and 2009. The only exception is the year 1978 in which France presents a labour productivity in MMA 1.3% higher than the corresponding one of the USA.

The evidence presented in the previous figures provides support for the idea that an index of development that combines both features (the relative importance of the modern activities in total labour force and their distance to the technological frontier) is well suited to capture the complex dimensions of structural transformation in a single measure. The following figure presents the relationship between our index of structural modernization and the level of per capita incomes in our sample of countries.

Figure 4. *Structural Modernization Index (**Ω**) by levels of per capita Gross National Income (GNI), at constant PPP dollars of 2005. Five year averages between 1950 and 2009 for 97 countries.*



As we can see, a clear positive and decreasing relationship can be observed between our index of structural modernization and the level of incomes. Again, this relationship seems to grow steadily, at a very similar rate across low, lower-middle and upper-middle ranges of income. Once the economy has surpassed the 25.000 dollars of per capita income, the slope of the fitted curve seems to decrease slightly, but the positive relationship stays quite strongly. As further indications of this positive correlation, we have explored the goodness of fit when imposing a quadratic functional form on the relationship, and it yields a very good fit, with an R-square of about 0.90.[44]

In what follows we will use the two main components of our index of structural modernization to study in more detail the countries caught in some sort of development trap. In particular, we will try to

[44] Interestingly, if we impose a quadratic relationship to the previous figure we also get a very good fit, but with a lower R-square (0.80). This would suggest that our index of modernization is better suit to capture the transformations that take place as countries get richer.

address the following research questions: a) Are certain regions of the (λ, ρ) landscape associated with low and middle income traps? And if so: b) Is it possible to establish a typology of countries according to their position in that landscape?

5. DEVELOPMENT TRAPS

In a first approximation, the figures presented in the previous section could be interpreted as reflecting a series of structural transformations that countries would typically undertake in their transition from low- to middle- and then high-income status. As we have previously stated, however, some observations in these figures could also represent countries that are unable to make such transformations and therefore cannot move upward in the income ladder.

Both situations are actually coexisting in the figures and can only be disentangle by means of a proper and manageable definition of low- and middle-income traps. As we have detailed in Section 2.2, in this paper we use a modification of the approach developed by Felipe (2012) and we define these traps according to the number of years that a country has been categorized within a certain income level. Following the procedure already explained we have identified the following thresholds: 31 years for the upper-middle income trap, 41 years for the lower-middle income trap and 27 years for the poverty trap.[45]

Thus, any country that in 2013 has been classified as upper-middle income for more than 31 years is categorized as being in the upper-middle income trap. By the same token, any country that in 2013 has been classified as a lower middle-income country for more than 41 years is categorized as being in the lower middle-income trap. As we have previously explained, we also consider the cases of those countries that have recently turned into a new income category but, given their slow growth rate in the last decades, are likely to be trapped as well in one of these middle income traps. In these cases, we project the total number of years that they will be in that particular income category by using the average annual growth rate of the period 1993-2013. If that number is greater than the corresponding threshold, the country is also included among the trapped group.

Finally, all countries that in 2013 are classified as low-income and, according to our projections, will take more than 27 years to graduate from this category are considered as being caught in a poverty trap.

Using this procedure in our sample of 100 countries we have identified 52 countries that have successfully transited to a higher income level category during the period under analysis and do not show evidence of being currently *trapped* in that category. These successful experiences are summarized in the following transition matrix.

[45] The detailed tables and corresponding distributions used to define these thresholds can be found at the end of the paper in Appendix 1.

Table 2. *Transition matrix for countries that have successfully improved their income category between 1950-2013 and are unlikely to be in the middle income trap (MIT). 52 countries.*

Starting Year \ Ending Year	Low Income	Lower-Middle Income	Upper-Middle Income	High Income
Low Income		*Indonesia, India, Sri Lanka, Mongolia, Vietnam*	*Botswana, Bulgaria, China, Malaysia, Mauritius, Thailand*	*Korea, Taiwan*
Lower-Middle Income			*Azerbaijan, Costa Rica, Kazakhstan, Peru, Turkey, Uruguay*	*Austria, Chile, Croatia, Cyprus, Finland, France, Greece, Hong Kong, Hungary, Ireland, Israel, Italy, Japan, Poland, Portugal, Singapore, Slovenia, Spain*
Upper-Middle Income				*Australia, Belgium, Canada, Denmark, Estonia, Germany, Latvia, Lithuania, Netherlands, Norway, New Zealand, Slovak Republic, Sweden, United Kingdom*
High Income				

Each cell in the matrix lists those countries that have transited from the category stated in the rows to the category stated in the columns. Since we are only looking at successful cases (i.e., countries that improve their category), all countries that would fall in or below the main diagonal are not considered. Within these countries, the most successful are the ones that managed to move the greatest number of categories. These are the countries in the most upper-right cell: Korea and Taiwan. These are the only two economies in our sample that transited from low to high income status within the period studied. Next, we have countries that have climbed two categories, either moving from low to upper-middle income status (Botswana, Bulgaria, China, Malaysia, Mauritius and Thailand) or from low-middle to

high-income status (Chile, Hong Kong, Israel, Japan, Singapore and thirteen other European countries). Finally, we have a series of 26 countries that have climbed up one category during the period. Perhaps the most interesting among them are those that have managed to *escape* from the poverty trap and today do not seem to be trapped at lower-middle income levels: Indonesia, India, Sri Lanka, Mongolia and Viet-Nam. Not surprisingly, all of them are located in Asia.

Contrasting with the successful cases, there are 30 countries of our sample that could be characterized as being caught in some sort of low or middle income trap. The following table lists these cases[46]:

Table 3. *Countries in an Development Trap. 2013, 30 countries.*

Poverty Trap (9)	Low Middle-Income Trap (10)	Upper Middle-Income Trap (11)
Kenya	*Bolivia*	*Argentina*
Madagascar	*Egypt**	*Brazil**
Malawi	*Jordan*	*Colombia**
Mali	*Moldova**	*Ecuador**
Nepal	*Morocco**	*Macedonia*
Niger	*Namibia*	*Mexico*
Rwanda	*Pakistan**	*Romania*
Togo	*Philippines**	*Russia*
Zambia	*Ukraine**	*Serbia*
	*Yemen**	*South Africa*
		Venezuela

Note: the asterisk identifies countries that have been characterized as being in the MIT based on the projected number of years that they would still need to graduate from their current income category. See Table A-3 in Appendix 1 for the details.

The lists of countries detailed in each column of Table 3 are quite consistent with the secondary literature on country development performance. Starting form the last column, we note that many countries usually associated with the upper-middle income trap are included in this group. Among the most invoked, we can mention Argentina, Brazil, Mexico, and South Africa. The same holds for countries that are typically associated with the lower-middle income trap, such as Bolivia, Jordan and Morocco. Regarding the poverty trap, although the countries identified also match with regular

[46] The remaining 18 countries of our dataset not included in Table 2 and Table 3 are: a) countries that had high income status right from the early 1950s (Switzerland and the United States), or from the beginning of our series of per capita GDP (Czech Republic); b) countries that have not change their category but does not seem to be trapped at middle incomes (Georgia); and c) countries that had low incomes in 2013 but according to our projections will surpass this category faster than the corresponding threshold used to determine the poverty trap (Bangladesh, Burkina Faso, Cambodia, Cameroon, Ethiopia, Ghana, Kyrgyz Republic, Lesotho, Mozambique, Nigeria, Senegal, Sierra Leone, Tanzania and Uganda).

characterizations on this matter[47], the number seems quite small. This is partially explained by the fact that the sample of countries included in our dataset is very likely biased towards the most successful countries within this category. Countries most likely trapped at low incomes are, at the same time, countries with the worst data on national accounts statistics and sectoral employment. Hence, most of these countries might have been excluded from our analysis simply because there was not enough available information to build the indicators needed for our structural characterization.[48] Therefore, the nine countries presented in the table should be considered as representative of a much broader universe of countries. Also note that we have used conservative thresholds for defining a trap, because we want to exclude countries that are slowly but steadily growing out of poverty.

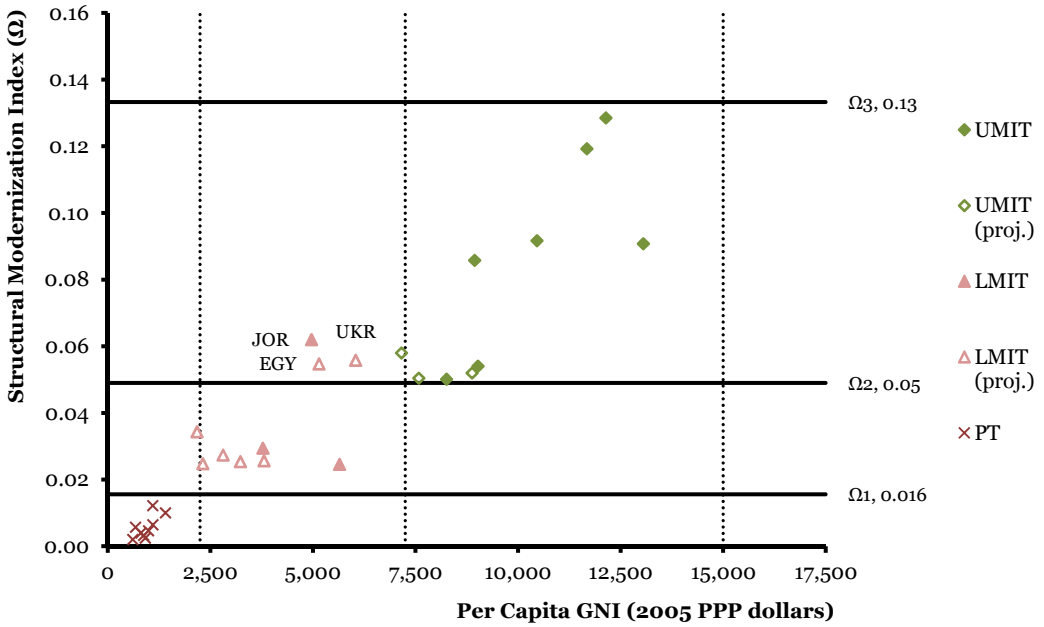
Having disentangled the successful and unsuccessful cases that were presented together in the previous section, we can now focus on the latter in order to get a first impression on the importance of structural modernization in order to escape from poverty and middle income traps. With this purpose, the next figure reproduces Figure 4 but only for those countries that are in some kind of development trap (i.e., the countries listed in Table 3). The importance of structural transformation stands out more clearly when we superimpose three thresholds indicating the minimum values of the structural modernization index that, according to our historical records, need to be surpassed in order to move from one income category to another. These thresholds are defined as the lowest value of Ω recorded across all countries of each income category (excluding low incomes) in the whole panel (that is, including also all observations between 1950 and 2009).[49]

[47] All of them, for example, are classified as Chronically Deprived or Chronically Partially Deprived countries by Anderson (2007) in a cluster analysis over 130 non-OECD countries between 1960 and 2003.

[48] The following countries (not included in our dataset) would also fall into the category of poverty trap applying our criteria to their per capita GNI figures: Benin, Burundi, Central African Republic, Congo, Côte d'Ivoire, Dem. Rep. of Congo, Eritrea, Guinea, Guinea-Bissau, Haiti, Syrian Arab Republic and The Gambia.

[49] These thresholds correspond to the following observations: Ω_1, Vietnam in the period 2005-09; Ω_2, Bulgaria in the period 2000-05; and Ω_3, Lithuania in the period 2005-09.

Figure 5. *Structural Modernization index by levels of per capita GNI at constant PPP dollars of 2005. Average values between 2005 and 2009 for countries in low or middle income traps.*

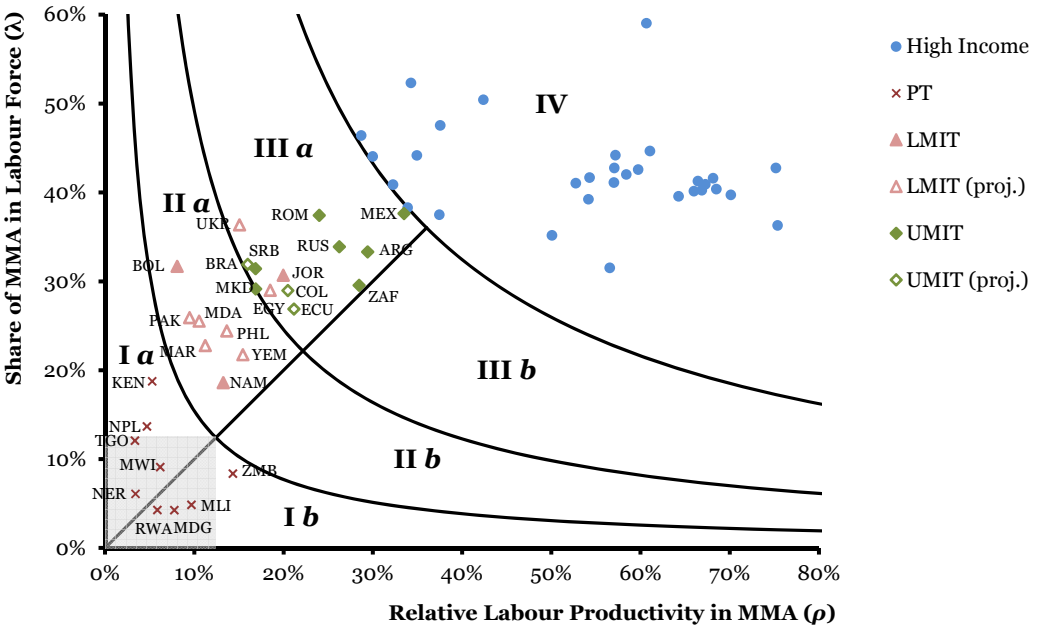


The observations of the figure are now divided in three broad groups in correspondence with the type of trap in which they are caught. For the middle income traps, a further distinction is made between the countries that are actually in the trap and those that would potentially be trapped according to our income projections.

As we can see, all countries caught in a poverty trap have an Ω index lower than 0.016. In the case of the countries in the lower-middle-income trap, the threshold value of 0.05 seems to constitute more a necessary but not sufficient condition to escape from this situation. Three out of ten countries have an index value larger than the corresponding threshold, but nevertheless remained trapped in the lower-middle income category in 2013 (Egypt, Jordan and Ukraine). Finally, in the case of the upper-middle income trap, the threshold limit of 0.14 seems to be a clear barrier for the countries trapped in this situation. In this case, all countries lie below that limit. It follows that a common feature shared by almost every country that we have identified as being caught in a development trap is that they have been unable to achieve the necessary level of structural modernization.

This aggregate picture indicates the importance of structural modernization in the process of development. However, it says little about the relative importance of each dimension. A more accurate view can be obtained by looking at the structural modernization landscape (as introduced in Figure 1). The next figure depicts this landscape for the period 2005-2009 in the case of the countries caught in a development trap. It also includes the high-income economies to illustrate the position in the landscape *occupied* by successful countries.

Figure 6. *Structural Modernization Landscape. Average values between 2005 and 2009 for high income countries and countries in a Development Trap.*



This figure is illustrative of a series of important characteristics that are worth exploring in detail. It provides graphical evidence about the interactive nature of structural change and technological catching up in the context of economic development. In particular, it illustrates how different countries might get trapped in a developmental trap if they are not able to perform a radical transformation of their productive structures. The figure has been divided in four regions based on the level curves (contours) of the structural modernization index that correspond to the thresholds presented in Figure 5. As explained before, each curve indicates the (observable) minimum value of Ω needed to move from one income-category to the next one. All regions below the third level curve have been further separated in two sub-regions by the 45 degree line, in order to stress the different relative importance of each dimension in achieving higher modernization level. To the left of this line (sub-regions *a* in the figure), increases of ρ would "pay off" more than increases in λ in terms of the impact that this would have in Ω. To the right of this line (sub-regions *b*), instead, increases of λ would have a larger relative impact on the resulting index. The figure also distinguish a grey area in which both dimensions (ρ and λ) would be simultaneously lower than the minimum average needed to arrive to the first level curve. As we will see, this region is particularly interesting because it would contain the economies at the earliest stage of development.

Now, looking at each region we can find interesting clustering of cases. Starting from the upper right corner of the landscape (the *peak of the three dimensional mountain*), we can see that all high-income

economies are located in *Region VI*. This, of course, is an outcome obtained by construction since the corresponding level curve has been constructed using the lowest level of Ω exhibited across all high income observations of our panel. Exactly at the opposite side of the landscape, in *Region I* (the *foot of the mountain*), we find all the countries identified as being caught in a poverty trap. Within this group, it is possible to differentiate three stylized cases. First, there are six countries (Mali, Malawi, Madagascar, Niger, Rwanda and Togo) in which the modern sector not only employs a negligible share of total labour force, but also present an extreme gap with respect to the world frontier. These are the countries located in the shaded region of the figure. Undoubtedly, these countries face the largest challenge ahead in terms of structural modernization. Secondly, there are two cases (Kenya and Nepal) that though having a very low index of structural modernization have a relatively large modern sector. These are the countries located in the non-shaded part of *Region Ia*. Contrasting with this case, a third stylized situation is illustrated by Zambia, which presents an extremely small modern sector but one that is relatively closer to the technological frontier, and thus is located in the non-shaded part of *Region IIa*.

Between these two extremes of the landscape, we find all countries caught in a middle-income trap. The countries that are identified as being caught in the lower-middle-income trap are mostly located in the Region *IIa*. In these countries, the modern sector has expanded sufficiently to escape the poverty trap, but the technological distance to the world frontier is still extremely large. Three special cases are Jordan, Egypt and Ukraine that have managed to enter in the next region of the landscape in terms of the modernization index but are still trapped in the lower-middle-income category. From a structural perspective, their economies are more similar to those countries situated at upper-middle income levels.

Most countries identified as caught in the upper-middle income trap, in turn, are located in (or at the border of) the *Region IIIa*. These countries are in an intermediate situation. They already managed to surpass the poverty and lower-middle income traps but did not succeed in going further. These economies already have a medium-sized modern sector that, in many cases, is comparable in size to that of the advanced economies. The main challenge, hence, seems to be especially in the technological dimension: these countries need to reduce the technological gap with the world frontier in their modern activities. The only exception to this rule might be Argentina and South Africa, which are located in *Region IIIb*, though very close to the 45 degree line. In these economies, the expansion of the modern sector would be at least as important as the reduction of the technological gap.

The following table lists all countries identified as being in a development trap, according to their location in Figure 6:

Table 4. *Countries in a Development Trap by regions of the structural modernization landscape. 2005-2009. 29 Countries*[50]

I*a*	I*b*	II*a*	II*b*	III*a*	III*b*
Kenya (L)	*Madagascar (L)* †	*Bolivia (LM)*	-	*Argentina (UM)*	-
Malawi (L) †	*Mali (L)* †	*Namibia (LM)*		*Brazil (UM)*	
Niger (L) †	*Rwanda (L)* †	*Morocco (LM)*		*Colombia (UM)*	
Nepal (L)	*Zambia (L)*	*Moldova (LM)*		*Ecuador (UM)*	
Togo (L) †		*Pakistan (LM)*		*Egypt (LM)*	
		Philippines (LM)		*Jordan (LM)*	
		Yemen (L)		*Macedonia (UM)*	
				Mexico (UM)	
				Romania (UM)	
				Russia (UM)	
				Serbia (UM)	
				South Africa (UM)	
				Ukraine (LM)	

Note: Between brackets we detail the income category (L=Low, LM=Lower-Middle, UM=Upper-Middle). The *dagger* (†) indicates low-income countries located in the shaded area of *Region I*.

The localization of the various countries in Figure 6 stresses once more a very important point already highlighted earlier in this paper. One of the main challenges in the process of economic development seems to be how to move from *Region I* to *Region IV* in the structural modernization landscape without getting trapped in between. As we will see in the next section, this is a challenge that only a few countries have managed to accomplish in the recent economic history.

Interestingly, the various regions of this figure can also be associated with the basins of attraction of the multiple equilibria found, from a theoretical perspective, in the model developed in Lavopa (2014a). The dynamical solution of that model yields four equilibria that can be stable or unstable depending on certain conditions in the underlying parameters. In particular, at very early stages of development, an equilibrium located at the origin would typically be stable. The basin of attraction of this equilibrium could easily be associated with the shaded part of *Region I* in Figure 6, and therefore, it makes a lot of sense to find many of the countries caught in the poverty trap here. The next two equilibria correspond to situations in which only one of the variables is different from zero. Therefore, the basis of attraction of these equilibria could easily be associated with the non-shaded areas of *Regions I* and with *Region II*. Countries trapped in the lower-middle income trap (or even in the

[50] As stressed before (see footnote 40) Venezuela is excluded from the figures because it presents and extremely high level of relative productivity in MMA mostly explained by the oil sector.

poverty trap) would be typically (given the underlying parameters) be attracted towards these two equilibria, as it seems to happen in Figure 5. The last equilibrium of the model (the *good* equilibrium), instead, is characterized by having positive values in both dimensions and therefore it would typically fall somewhere within *Regions III* and *IV*. The exact point in which it would fall will depend on the underlying parameters. As customary in this type of models higher levels of absorptive capabilities, domestic efforts in R&D investments or income-elasticity of export demand will typically increase the equilibrium values and therefore tend to move the equilibrium towards *Region IV*. Higher levels of price inflation, income-elasticity of import demand or labour force growth, instead, would decrease the equilibrium values and therefore move the equilibrium towards *Region III*. Perhaps more interestingly, for economies trapped within *Regions I* or *II*, the theoretical model would provide interesting insights about broad economic strategies needed to overcome the obstacles driving the economy towards the bad equilibria and to escape from these regions. In short, this strategy would entail a radical transformation in export performance grounded on a structural shift towards the production of goods with higher income elasticity of demand in world markets and a radical improvement in the domestic absorptive capabilities of the domestic economies in order to tap into the global flows of technological knowledge. Both transformations would turn the good equilibrium stable thus enabling the economy to move away from the basin of attraction of the low-level equilibria.[51]

Given the clear match between regions and income-status (most countries trapped in low or lower-middle incomes being in regions I and II, and most countries trapped in upper-middle incomes being in *Region III*)[52], it is possible to derive a typology of countries caught in some sort of development trap according to the dimension (in our 2-dimensional landscape) that they need to improve more radically in order to escape from the trap:

[51] See Lavopa (2014a), Section 5.

[52] The only exceptions are the three countries categorized as being in the LMIT but posited in *Region IIIa* (Egypt, Jordan and Ukraine).

Table 5. *Typology of Countries based on the Regions of the Structural Modernization Landscape*

		In order to surpass	
		Low or Lower-Middle Income Trap	Upper-Middle Income Trap
Needs to improve	Technological accumulation	*Regions Ia and IIa*	*Region IIIa*
	Labour Absorption	*Regions Ib and IIb*	*Region IIIb*
	Both	*Region I (shaded area)*	-

Looking at Table 4 and Table 5 would suggest, for example, that the main challenge in countries such as Argentina and South Africa would be related to increase the size of the modern sector whereas in Brazil, Mexico and Russia, for example, it would be more urgent to improve the degree of technological sophistication of the already existing modern activities.

The cross-country approach used in this section provides an interesting starting point to analyse economic development. But the picture we obtain is still rather stylized and provides little insights on the particular structural trajectories followed by different countries. To overcome this limitation, in the following section we focus on a selected number of countries –each of them representative of one of the different situations described above– and we analyse their evolution through the structural modernization landscape in the last four or five decades.

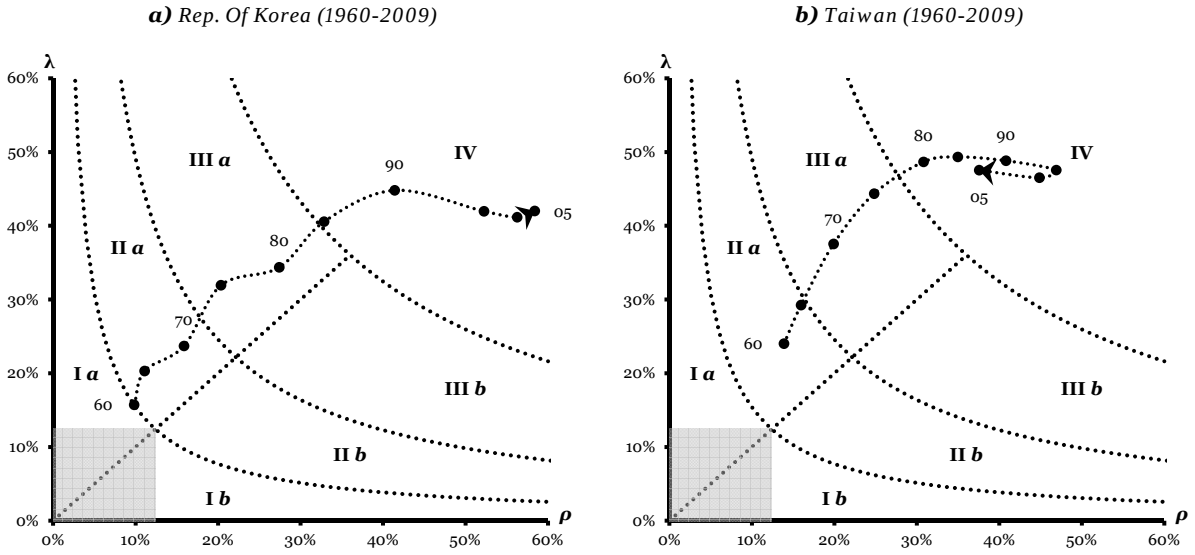
6. STRUCTURAL TRAJECTORIES

In this section we present the structural trajectory of a series of countries that can be regarded as representative of the various development outcomes that have been identified so far. Two broad groups are analysed. First, what we call "successful trajectories". These are economies that have improved their income category during the period and do not present evidence of being currently caught in any sort of development trap. Within this group we present six countries selected from Table 2. The criterion here has been to pick two cases from each of the right-most upper cells of the table. The second group illustrates what we call "unsuccessful trajectories" and is composed by economies that have been identified as being currently caught (or projected to be caught) in some sort of development trap. Within this group we also present six countries selected from Table 3. In this case, we chose two cases for each income trap.

6.1. Success Stories

Examples of successful trajectories include the following: Korea and Taiwan (which managed to move from low to high incomes during the period); Hong Kong and Singapore (which managed to move from lower-middle to high incomes); and China and Thailand (which managed to move from low to upper-middle incomes). To analyse the structural trajectories we present a set of figures with the corresponding structural modernization landscape and the position of each country in different points of time, starting (when the data is available) in 1960 and ending in 2009. In all cases, the points in the figures represent averages across five-year periods, starting on the year indicated next to the observation. The landscapes have been divided in the various regions defined in Figure 6, which –as we will see– provide useful insights on the interpretation of the trajectories observed.

Figure 7. *Structural Trajectories (Five year averages). Rep. of Korea and Taiwan, 1960-2009*

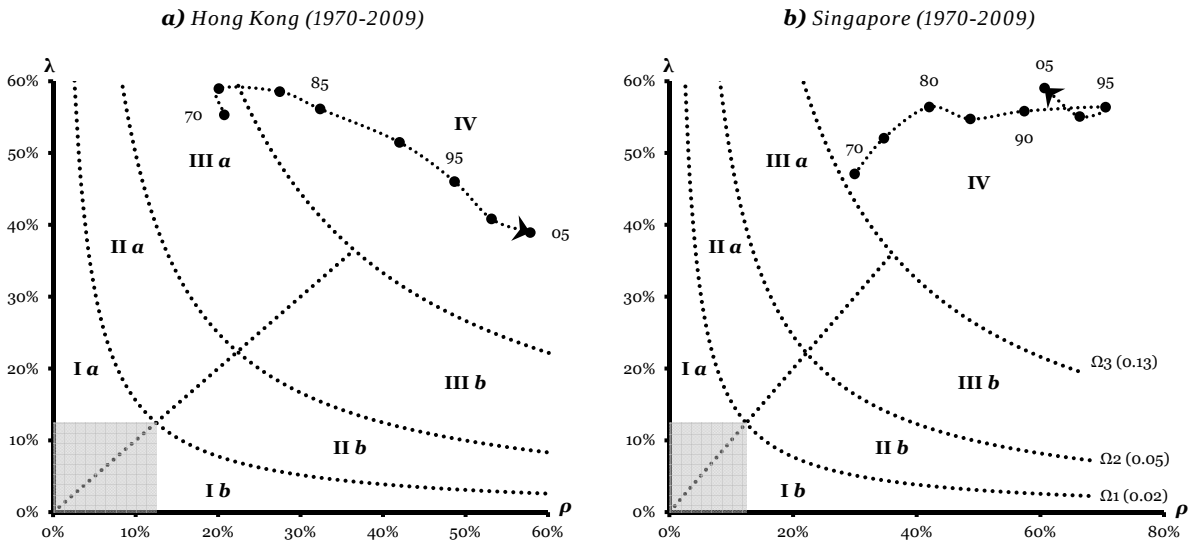


Panel *a* in Figure 7 depicts the structural trajectory of Korea between 1960 and 2009. Undoubtedly, this is one of the most astonishing trajectories within our sample of countries during the period considered. In the early 1960s Korea was a low-income economy situated at the border of the worst region of the landscape. Both the share in total labour force and the relative labour productivity of modern market activities were extremely low. In a time span of three decades, this economy managed to transform its structure radically moving from the lower bound of *Region IIa* to the centre of *Region IV* and attaining by the second half of the 1990s the status of high-income economy. The trajectory resembles a straight diagonal crossing *Regions IIa* and *IIIa* to end up at a level of 45% of total labour force in the modern activities by the early 1990s and keep that level with a significant reduction of the technological gap in the following years.

The trajectory of Taiwan (panel *b*) illustrates another of the most successful stories in our sample. Starting from *Region IIa* (with a modern sector that was comparatively larger than the one of Korea, but equally far from the technological frontier), this economy also managed to simultaneously increase the size of its modern sector and reduce the technological gap at a very rapid pace, moving in ten years to *Region IIIa*, and ten years later to *Region IV*. In a quarter century, Taiwan radically transformed its structure and became a high-income economy. Contrasting with Korea, however, this economy could not maintain its rate of catch-up. After 2000 it started to lose some ground with respect to the world frontier.

Next we present the cases of four economies that managed to climb two income categories during the period under consideration. We start with the remaining Asian tigers: Hong Kong and Singapore. In this case, our data start in the 1970s. Figure 8 shows the corresponding trajectories.

Figure 8. *Structural Trajectories (Five year averages). Hong Kong and Singapore, 1970-2009*



Both economies were categorized as lower-middle income in the early 1960s (not shown in the figure) and had already managed to achieve high incomes by the beginning of the 1980s. As we can see, by the early 1970s they already had a very large modern sector and their main achievement was to significantly reduce the technological gap with the world frontier. Actually, in the case of Hong Kong we can see a steady decline in the share of modern activities in total labour force, mainly driven by the sharp drop in manufacturing shares. In Singapore, in contrast, the share of modern activities continues to grow until the early 1980s and later stays at the same level. Since 1995 the Singapore economy has been falling behind in a technological sense.

The last two successful economies that we present are also situated in East Asia: China and Thailand. Both economies started the period as low-income economies and managed to climb up to upper-middle income economies. The challenge for these economies is now to graduate from this income category, and avoid the trajectory followed by the trapped economies that we will analyse in the next section.

Figure 9. *Structural Trajectories (Five year averages). China and Thailand (1960-2009)*

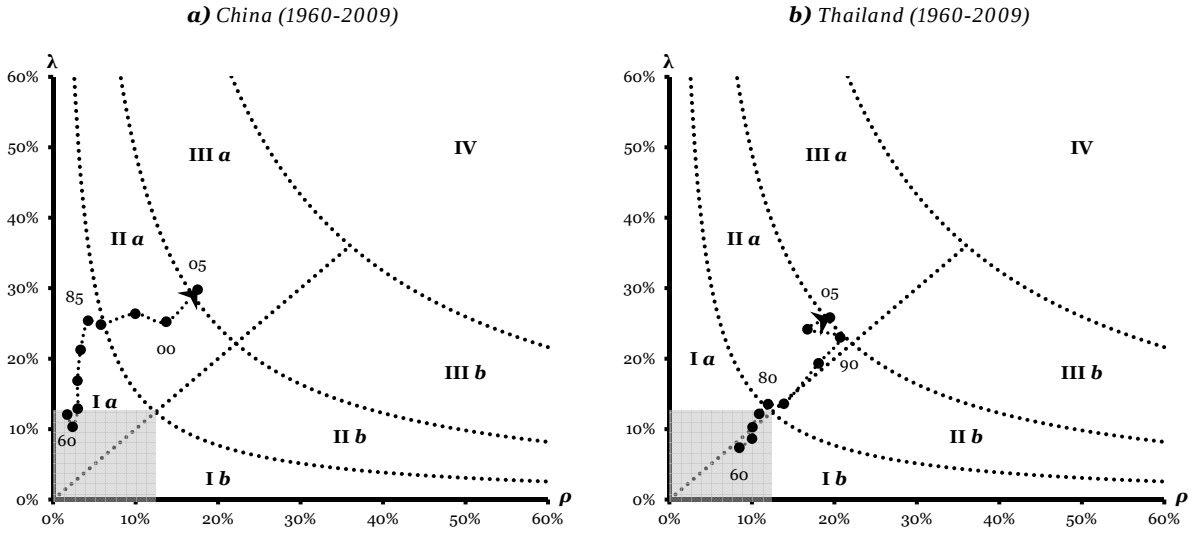


Figure 9 clearly shows the important achievements of China, especially during the last 25 years. Between 1960 and 1970 this economy was stuck in the worst region of the landscape. After this year, however, a dramatic shift in the structure of employment leads to a steady increase in the relative size of the modern sector, that in 15 years increases by more than 10 percentage points. During the next 15 years, the expansion of the modern sector stops but in a context of rapid catch up with the world frontier. Finally, in the last years, the economy combines a steady increase along both dimensions. Between endpoints, the Chinese economy has managed to move from *Region Ia* to *Region IIIa*, in a clear successful structural transformation trajectory. The case of Thailand also provides a good illustration of a successful trajectory. Starting at very low levels in the 1960s, this economy slowly managed to increase the size of the modern sector and reduce the technological gap. By the second half of the 1980s absorption of labour force in the modern sector accelerated substantially and by the mid 1990s Thailand entered into *Region IIIa*. During the 1990s and 2000s Thailand managed to maintain its upward trend but lost some ground in terms of technological catching-up. As in the case of China, this economy now faces the challenge of maintaining the pace of the structural modernization to go beyond *Region III* and avoiding falling in the upper-middle income trap.

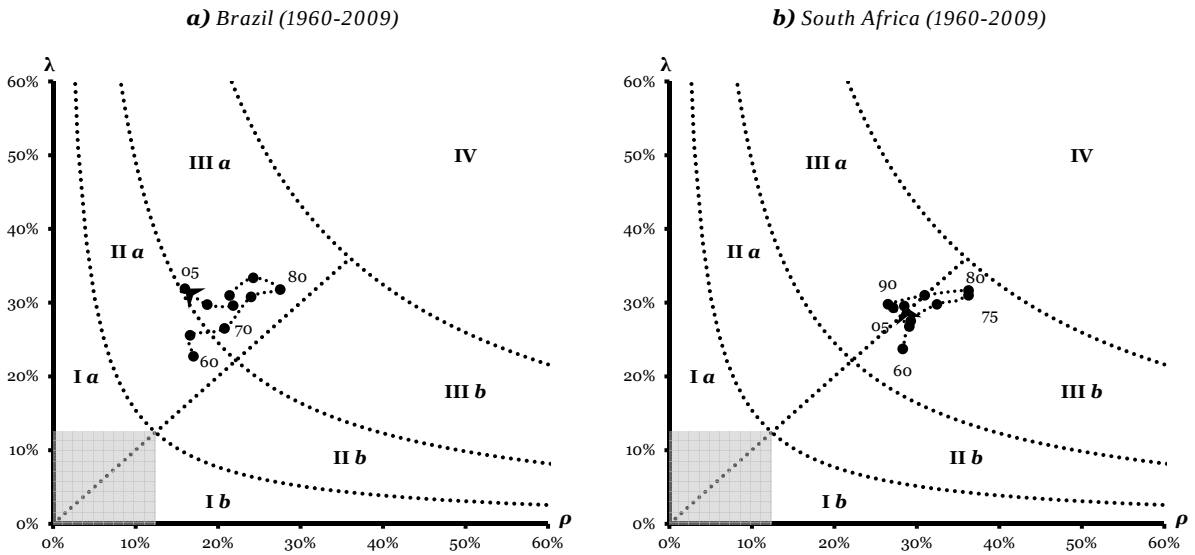
Having reviewed some of the most representative successful cases, we turn now to analyse the structural trajectories of a number of countries that, according to our empirical analysis, have fallen in some sort of development trap.

6.2. Unsuccessful Trajectories

The unsuccessful trajectories are illustrated with two cases from each income trap: Brazil and South Africa (upper-middle income trap), Bolivia and Philippines (lower-middle-income trap) and Malawi and Zambia (poverty trap).

Our first pair of unsuccessful stories illustrates the upper-middle-income trap and clearly shows cases in which the economy has been caught in one region of the landscape with great difficulties in moving forward for a very long period. Although this trajectory is illustrated with the cases of Brazil and South Africa, other countries (such as Argentina or Colombia) also present similar trajectories.

Figure 10. *Structural Trajectories (Five year averages). Brazil and South Africa, 1960-2009*

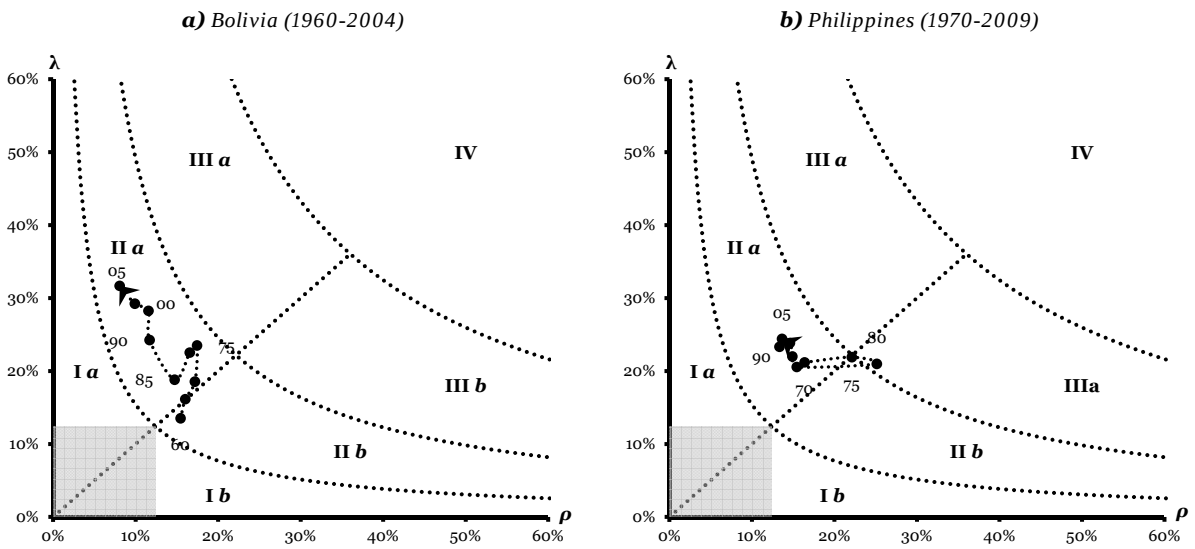


For almost half a century the two economies presented in Figure 10 have been trapped in *Region III* of the landscape. The economy of Brazil showed an impressive structural modernization between 1960 and 1980 (the so called *Brazilian miracle*). During these years the economy managed to move from *Region IIa* to the upper right corner of *Region IIIa*, significantly increasing the size of the modern sector and improving the degree of technological sophistication. From the 1980s onward, however, there has been a steady increase in the technological gap, while the size of the modern sector was maintained. By the end of the 2000s the technology gap was almost as large as it was in the early 1960s. A similar story can be told about South Africa. Looking at panel *b* of the figure, we see that it also showed an important structural modernization between 1960 and 1980, but then fell behind. By the early 1990s, the relative productivity in the modern sector was even lower than in the early 1960s. During the 1990s and 2000s this tendency of declining relative productivity was reversed. But the

recovery in productivity performance went hand in hand with a decreasing share of modern activities in the total labour force (mainly due to extremely high and increasing rates of unemployment). At the end of the period this country was almost at the same point as in the late 1980s.

We turn now to the cases of Bolivia and Philippines, two countries trapped at lower-middle income levels and with a similar tendency to move towards the upper-left corner of *Region IIa* (see Figure 11). The structural trajectory of these economies is also quite similar. Till the late 1970s, these economies were moving progressively from *Region II* to *Region III*. From the 1980s onward, however, they started to lag behind in technological terms (a leftward movement in the landscape) although they continued to increase the size of their modern sectors. This is especially true for Bolivia, where the modern sector jumped from less than 20% in the late 1980s to more than 30% today. In both cases, however, the direction of the trajectory seems to be towards the upper-left corner of *Region IIa*, which would clearly indicate the great difficulties that these economies face in order to move upwards in the structural modernization landscape. If structural modernization is indeed the key to escape from middle-income traps, then these trajectories provide warning signals about prospects of these economies to escape the lower-middle-income trap.

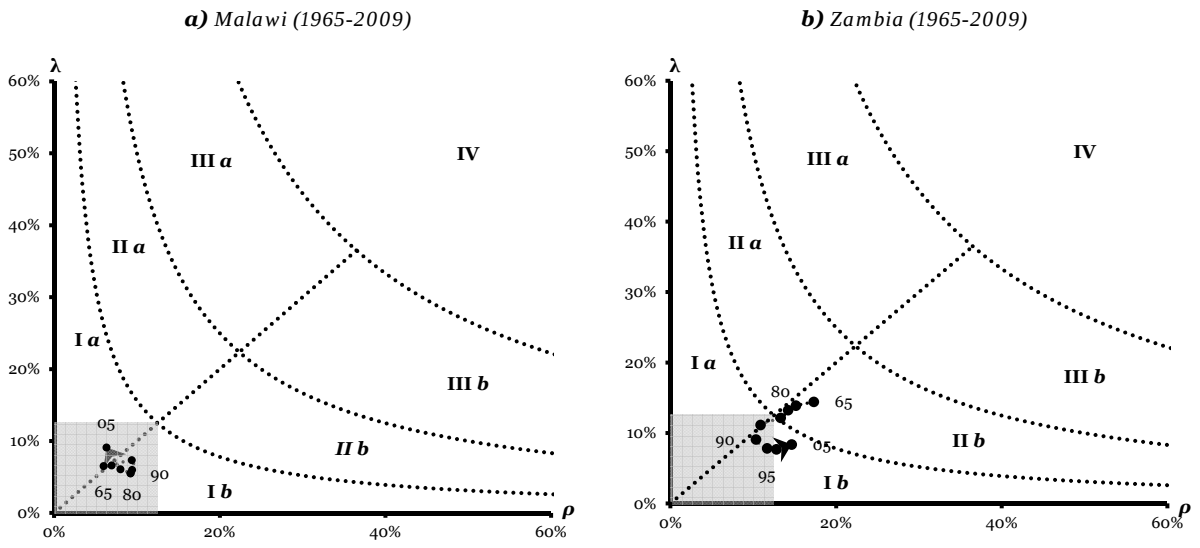
Figure 11. *Structural Trajectories (Five year averages). Bolivia (1960-2009) and Philippines (1970-2009)*



The last pair of countries that we discuss is not only caught in the poverty trap but also face difficulties in moving away from the shaded part of *Region I*. The perspectives for these countries are therefore the least optimistic ones (see Figure 12). This type of trajectory is illustrated with the cases of Malawi

and Zambia, but it should be kept in mind that other countries such as Madagascar, Mali, Niger or Rwanda would probably present similar trajectories.[53]

Figure 12. *Structural Trajectories (Five year averages). Ethiopia and Tanzania, 1960-2009*



As we can see, these economies have been trapped in the very bottom of *Region I* at least for the last four decades. In such a situation, the main challenge ahead seems to be the development of a modern sector capable of absorbing an increasing share of the labour force. The case of Zambia in the first decades after the independence is particularly discouraging. Between 1965 and 1990, the relative size of the modern sector showed a significant reduction while its technological gap was increasing steadily, in a trajectory directed right towards the worst region of the landscape. The situation seems to have improved in the last decade, though the modern sector still represents a modest portion of the economy.

[53] Unfortunately we have not been able to collect the necessary data to build similar figures for these countries. In particular, data on employment by sector before the 2000s are rarely available. Nevertheless, the available data for the last period shows that all of them are located in the shaded are of Region I, as illustrated in Figure 6.

7. CONCLUSIONS AND FUTURE STEPS

In this paper we have proposed a new index to analyse the process of structural transformation that unfolds as countries develop. This index has been theoretically grounded in a series of contributions from different strands of literature that place structural change and technological catch up at the centre of economic development. It has been calculated for a large sample of countries over a long period of time, and the results have been used to shed new light on the reasons why some countries might be caught in development traps.

Our findings highlight the fundamental role played by the structural modernization of the economy in the process of economic development and, at the same time, stress the important risks associated with the lack of such transformation. In short, countries that have not managed to move forward in the structural upgrading of their productive systems, ended up being stuck in different sorts of low- or middle-income traps.

This paper should be considered as an exploratory first step in a broader research programme. Some interesting questions are deliberately left open for further exploration. Two in particular stand out. First what are the determinants of the occurrence (or non-occurrence) of structural modernization. The literature reviewed has already identified several potential determinants that need to be examined in empirical research. These candidates could be grouped in two broad categories. On one hand, there is a series of factors affecting the technological capabilities of the countries –and thus, the supply side of the economy– such as the domestic efforts in R&D, the national capabilities to absorb foreign technologies and the scope for imitation and diffusion of technology. On the other hand, there are several factors affecting the demand faced by the domestic economy, such as the terms of trade in international transactions, the income-elasticity of exports and the macroeconomic environment. The specific effect of these and other factors can be tested using econometric techniques over the large panel dataset that has been constructed for this paper. In future research we intend to explore this avenue.

The second question has to do with the composition of structural change and the changes that take place as countries develop within our aggregate category of modern market activities. A long strand of literature has stressed that the very nature of technological catch up is itself closely tied to the upgrading of the economy towards activities that are more technology intensive. The broad sectoral disaggregation used in this paper, unfortunately, does not allow us to study the effects of such changes. The structural composition of the modern sector itself and its structural transformation along time will definitely affect the size of aggregate technological gap of the modern sector. Therefore, an exploration of the sectors that make up the modern market aggregate and their changes over time would significantly improve our understanding of why some countries manage to rapidly close the

technological gap while other lag further behind. This is another avenue of research that we aim to exploring in the future.

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9. APPENDIX 1: DEVELOPMENT TRAPS

In this appendix we present the detailed data used to determine the thresholds needed for our operational definition of the development traps.

The first two tables specify the list of countries that have transited from lower middle to upper middle incomes (Table A-1) and from upper-middle to high incomes (Table A-2) during the period under analysis. As explained in Section 3.2, the average number of years needed to graduate by the upper quartile of these countries has been used to determine which countries are now in the lower-middle income trap and the upper-middle income trap. The corresponding results are presented in Table A-3, which specifies the relevant information for all countries of our sample that in 2013 were classified as middle-income economies. In particular, for each of these countries it provides information on: a) the number of years it has been in its current category since 1950; b) the average annual growth rate of per capita GNI between 1993 and 2013; and c) the projected total number of years it will be in its current category given the growth rate of the last two decades. Our identification of countries that are already in the middle income trap or are projected to be in the middle income trap arise from the comparison of a) and c) with the corresponding thresholds, as indicated in the last column of the table.

Next, in Table A-4 we detail the list of low-income countries in our sample, their average annual growth rate over the period 1993-2013 and the projected number of years they will need to overcome this income category, given that growth rate. As explained before, the distribution obtained is used to determine the countries in the poverty trap.

At the end of this appendix we also present three figures illustrating the distributions of countries used to determine the corresponding thresholds, with the relevant descriptive statistics.

Table A-1. *Economies that turned to lower-middle incomes (LMI) after 1950 and graduated to upper-middle incomes (UMI) before 2014. 11 countries.*

id	Country	Turning year		Years needed to *graduate*
		became LMI	became UMI	
CHN	China	1998	2011	13
TWN	Taiwan	1963	1979	16
BWA	Botswana	1973	1990	17
KOR	Korea	1966	1985	19
MKD	Macedonia	1955	1976	21
SRB	Serbia	1959	1981	22
THA	Thailand	1981	2008	27
MYS	Malaysia	1962	1992	30
MUS	Mauritius	1959	1995	36
BGR	Bulgaria	1958	2001	43
BRA	Brazil	1951	1994	43
	Median			**22**
	Standard Deviation			**11**
	Upper Quartile			**33**
	Average for the Upper Quartile			**41**

Table A-2. *Economies that turned to upper-middle incomes (UMI) after 1950 and graduated to high incomes (HI) before 2014. 20 countries.*

id	Country	Turning year		Years needed to *graduate*
		became UMI	became HI	
GRC	Greece	1963	1973	10
JPN	Japan	1963	1973	10
KOR	Korea	1985	1995	10
HKG	Hong Kong	1969	1980	11
SGP	Singapore	1970	1981	11
TWN	Taiwan	1979	1991	12
SVN	Slovenia	1962	1975	13
ESP	Spain	1962	1977	15
AUT	Austria	1955	1971	16
ITA	Italy	1957	1973	16
FIN	Finland	1957	1974	17
CYP	Cyprus	1969	1987	18
FRA	France	1952	1970	18
CHL	Chile	1992	2012	20
PRT	Portugal	1969	1989	20
IRL	Ireland	1968	1990	22
ISR	Israel	1964	1987	23
HUN	Hungary	1971	2004	33
POL	Poland	1971	2007	36
HRV	Croatia	1966	2006	40
	Median			**17**
	Standard Deviation			**9**
	Upper Quartile			**21**
	Average for the Upper Quartile			**31**

Table A-3. *Characterization of middle-income economies (MIEs). 40 countries.*

ID	Country	Category in 2013	Year country turned to current category	Years in that category	Average annual growth rate (1993-2013)	Projected years to turn category	Total projected years in the category	Threshold	Status
		(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6) = (3)+(5)*	*(7)*	*(8)*
ARG	Argentina	UMI	1960	54	1.8%	6	60	31	UMIT
AZE	Azerbaijan	UMI	2009	5	5.9%	10	15	31	NT
BGR	Bulgaria	UMI	2001	13	3.2%	8	21	31	NT
BOL	Bolivia	LMI	1950	64	1.9%	27	91	41	LMIT
BRA	Brazil	UMI	1994	20	1.9%	21	41	31	UMITproj
BWA	Botswana	UMI	1990	24	2.6%	2	26	31	NT
CHN	China	UMI	2011	3	9.0%	7	10	31	NT
COL	Colombia	UMI	2006	8	1.9%	28	36	31	UMITproj
CRI	Costa Rica	UMI	1998	16	2.4%	14	30	31	NT
ECU	Ecuador	UMI	2008	6	1.7%	34	40	31	UMITproj
EGY	Egypt	LMI	1982	32	2.7%	10	42	41	LMITproj
GEO	Georgia	LMI	1980	34	5.6%	5	39	41	NT
IDN	Indonesia	LMI	1993	21	3.0%	18	39	41	NT
IND	India	LMI	2006	8	5.1%	16	24	41	NT
IRN	Iran	UMI	2000	14	2.3%	17	31	31	NT
JOR	Jordan	LMI	1961	53	2.7%	11	64	41	LMIT
KAZ	Kazakhstan	UMI	2004	10	3.3%	12	22	31	NT
LKA	Sri Lanka	LMI	1993	21	4.6%	6	27	41	NT
MAR	Morocco	LMI	1984	30	3.2%	15	45	41	LMITproj
MDA	Moldova	LMI	1980	34	1.3%	59	93	41	LMITproj
MEX	Mexico	UMI	1972	42	1.1%	14	56	31	UMIT
MKD	Macedonia	UMI	1976	38	1.8%	28	66	31	UMIT
MNG	Mongolia	LMI	2004	10	7.0%	7	17	41	NT
MUS	Mauritius	UMI	1995	19	3.4%	4	23	31	NT
MYS	Malaysia	UMI	1992	22	3.1%	1	23	31	NT
NAM	Namibia	LMI	1959	55	2.3%	5	60	41	LMIT
PAK	Pakistan	LMI	2006	8	2.0%	54	62	41	LMITproj
PER	Peru	UMI	2008	6	3.6%	16	22	31	NT
PHL	Philippines	LMI	1973	41	2.5%	24	65	41	LMITproj
ROM	Romania	UMI	1972	42	3.0%	9	51	31	UMIT
RUS	Russia	UMI	1980	34	2.4%	1	35	31	UMIT
SRB	Serbia	UMI	1981	33	5.8%	8	41	31	UMIT
THA	Thailand	UMI	2008	6	2.8%	22	28	31	NT
TUR	Turkey	UMI	1987	27	2.4%	4	31	31	NT
UKR	Ukraine	LMI	1980	34	0.7%	21	55	41	LMITproj
URY	Uruguay	UMI	1991	23	2.7%	4	27	31	NT
VEN	Venezuela	UMI	1950	64	0.5%	64	128	31	UMIT
VNM	Vietnam	LMI	2005	9	5.4%	15	24	41	NT
YEM	Yemen	LMI	2009	5	0.5%	-	-	41	LMITproj
ZAF	South Africa	UMI	1969	45	1.6%	26	71	31	UMIT

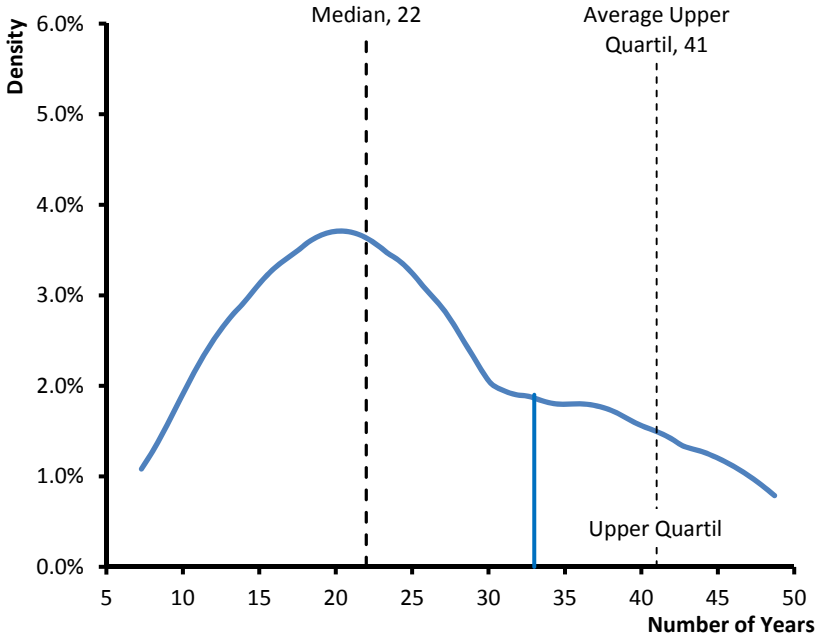
Note: The following abbreviations have been used: LMI = lower-middle income; UMI = upper-middle income; LMIT = lower-middle income trap; UMIT = upper-middle income trap; NT = no trapped; LMITproj = projected in the LMIT (i.e., using column 6 instead of 3); UMITproj = projected in the UMIT (i.e., using column 6 instead of 3).

Table A-4. *Projected number of years needed by the low income economies (LIEs) of our sample to turn into lower-middle income economies (LMIE), given the growth rate of the last 20 years. 23 countries.*

id	Country	Average annual growth rate (1993-2013)	Start	Turning Year	Years needed to *graduate*
NGA	Nigeria	3.8%	2013	2014	1
KHM	Cambodia	5.3%	2013	2015	2
KGZ	Kyrgyz Republic	1.4%	2013	2016	3
BGD	Bangladesh	4.3%	2013	2018	5
GHA	Ghana	3.8%	2013	2019	6
LSO	Lesotho	1.3%	2013	2022	9
CMR	Cameroon	1.1%	2013	2023	10
TZA	Tanzania	3.0%	2013	2029	16
BFA	Burkina Faso	3.0%	2013	2031	18
MOZ	Mozambique	4.8%	2013	2032	19
ETH	Ethiopia	4.0%	2013	2034	21
SLE	Sierra Leone	2.6%	2013	2034	21
UGA	Uganda	3.1%	2013	2037	24
SEN	Senegal	1.2%	2013	2038	25
NPL	Nepal	1.9%	2013	2042	29
KEN	Kenya	1.2%	2013	2043	30
RWA	Rwanda	2.1%	2013	2045	32
MLI	Mali	1.7%	2013	2059	46
ZMB	Zambia	0.7%	2013	2081	68
MDG	Madagascar	-0.2%	2013	-	-
MWI	Malawi	0.6%	2013	-	-
NER	Niger	0.8%	2013	-	-
TGO	Togo	1.0%	2013	-	-
	Average projected years *(exc. Madagascar, Malawi, Niger and Togo)*				**19**
	Standard Deviation *(exc. Madagascar, Malawi, Niger and Togo)*				**17**
	Upper Quintile *(exc. Madagascar, Malawi, Niger and Togo)*				**27**

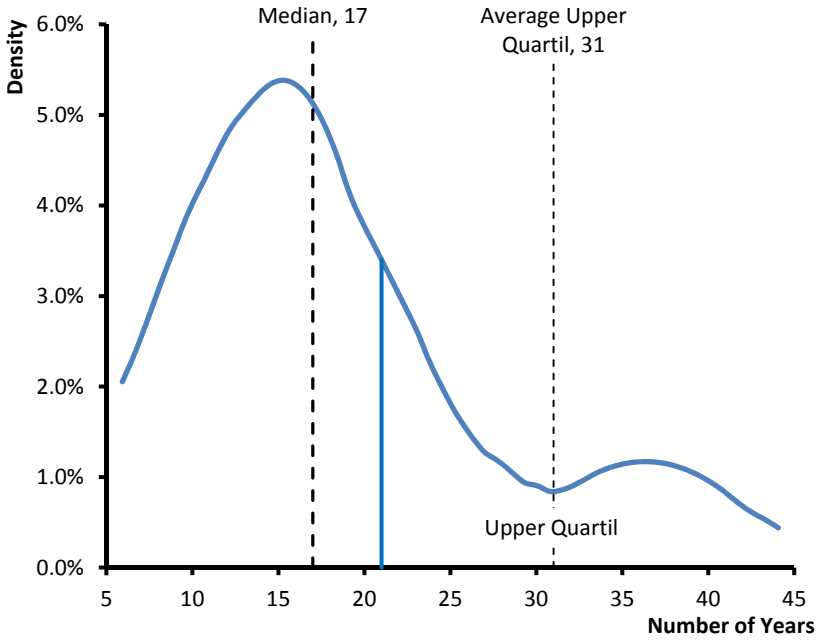
Note: Madagascar, Malawi, Niger and Togo are excluded from the distribution analysis because their projected number of years needed to graduate exceeds a century. Hence, they are directly considered trapped and not included in the comparison.

Figure A-1. *Distribution of countries according to the number of years they needed to graduate from lower-middle income (LMI) to upper-middle income (UMI) category.*



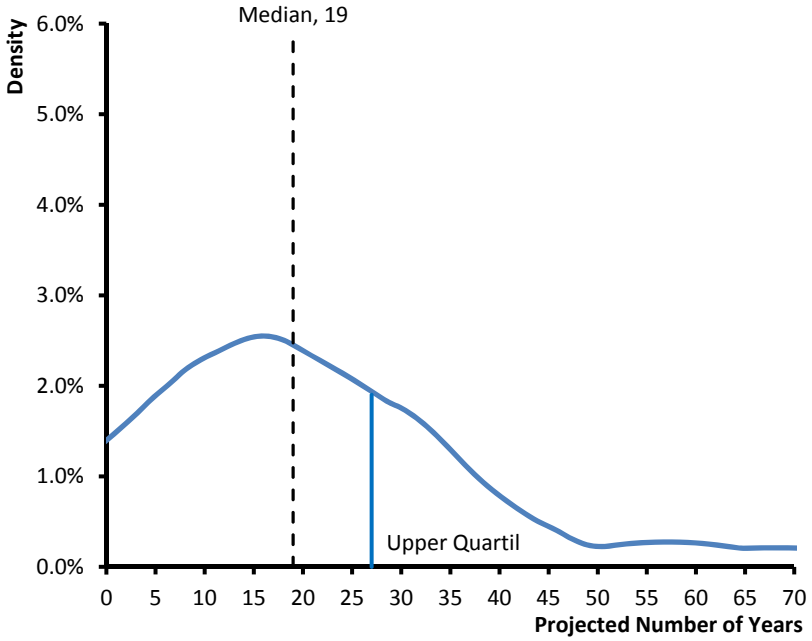
Note: This distribution has been calculated using the *kdensity* command of Stata 13, over the countries reported in Table A-1. The kernel used was Epanechnikov with a bandwidth of 3.7024.

Figure A-2. *Distribution of countries according to the number of years they needed to graduate from upper-middle income (UMI) to high income (HI) category.*



Note: This distribution has been calculated using the *kdensity* command of Stata 13, over the countries reported in Table A-2. The kernel used was Epanechnikov with a bandwidth of 6.0254.

Figure A-3. *Distribution of low income countries (LICs) according to the projected number of years they will need to graduate to the lower-middle income (LMI) category.*



Note: This distribution has been calculated using the *kdensity* command of Stata 13, over the countries reported in Table A-4. The kernel used was Epanechnikov with a bandwidth of 4.7422. When constructing the distribution the following countries have not been considered because their projected number of years needed to graduate exceeded a century: Madagascar, Malawi, Niger and Togo.

10. APPENDIX 2: CONSTRUCTING THE DATASET

In this Appendix we detail the specific procedures and data sources used for the construction of our dataset. The description is divided by variable. Section 10.1 presents the details for the per capita GNI figures, Section 10.2 for the sectoral employment and value added figures and Section 10.3, for the unemployment rates. The final section of this appendix presents detailed tables summarizing the specific data sources used (by year) for the construction of these variables in each country of our sample.

10.1. Per-capita GNI

Our figures of per capita GNI by country at 2005 PPP dollars are mainly taken from World Bank's World Development Indicators Database (WDI).[54] In order to expand the coverage of this variable along time and across countries, four additional sources have been used (in this order, depending on availability):

1) The Conference Board Total Economy Database (TED)[55]
2) Penn World Table 8.0 (PWT)[56]
3) Maddison Project Database (MPD)[57]
4) IMF, World Economic Outlook Database (WEOD)[58]

In all cases, the figures of per capita GNI from the WDI have been extrapolated using the growth rates of per capita GDP at constant prices published in the other sources. In Table A-6 we provide the details of the specific source used by country and years.

10.2. Sectoral Employment and Value Added

As it was briefly detailed in Section 3.3, our figures for sectoral employment and value added have been built using a wide array of sources. These sources have been first ordered according to their data quality, sectoral disaggregation and international comparability, and whenever possible, the *best available* sources have been given priority in the construction of the individual countries series. In what follows we describe the procedure used in different groups of countries according to the availability of data in the various sources detailed in Section 3.3.

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[54] Available at: databank.worldbank.org

[55] Version January 2014. Available at http://www.conference-board.org/data/economydatabase/

[56] Available at: www.ggdc.net/pwt. See Feenstra et al. (2013) for the details.

[57] Available at: www.ggdc.net/maddison. See Bolt and van Zanden (2013) for the details.

[58] Version April 2014. Available at http://www.imf.org/external/data.htm

For all countries covered by the WIOD[59] we built benchmark values at 2005 LCU for the year 2005 disaggregated at 35 industries. The figures at 35-industries were then converted into 2005 PPP dollars using the sector-specific convertors published in Inklaar and Timmer (2012)[60], and extrapolated to the whole period covered by the WIOD (1995-2009).

Wherever data at 35 industries was available for a longer period in the various KLEMS datasets (ASIA-KLEMS, EU-KLEMS or WORLD KLEMS), these estimates have been back cast using these data sources. Following this procedure, we were able to extend the figures of the WIOD disaggregated at 35 industries up to 1970 for 24 countries. For some countries not covered by KLEMS databases we also managed to extend this figures at 35 industries using other sources.[61] In the particular case of the United States, all information for the period 1950-2009 has been extrapolated at 35 industries using the dataset put forth by Jorgenson et al. (2012).

The data for most of these countries have been further extended to the beginning of the 1950s using the GGDC 10-Sector Database. In these cases, the figures were first reordered to match the 10 sectors defined in Table 1 and then back cast at this lower disaggregation.[62]

There are two countries for which Inklaar and Timmer (2012) presents sectoral PPPs at 35 industries, even though they are not included in the WIOD: Argentina and Chile. For these countries we built comparable figures on employment and value added at 35 industries using data coming from the National Statistics Institutes (NIS). In the case of Argentina, data of Value Added by sector at 3 digits of the ISIC was provided by the NIS for the period 1993-2007 (both at current and constant prices). This data was reordered to match the 35 industries of the WIOD and converted into 2005 PPP dollars. The numbers for employment at sectoral level (disaggregated at 10 sectors) were also taken from the NIS and also cover the period 1993-2007[63]. In the case of Chile, data on Value Added at sectoral level was collected from BCC (2011)[64] which provides information on National Accounts for the period

[59] This dataset covers 40 countries: the 27 EU countries plus Australia, Canada, Japan, South Korea, Taiwan, the United States and other 7 emerging economies (Brazil, China, India, Indonesia, Mexico, Russia and Turkey). All of them with the only exception of Malta are included in our dataset (Malta is excluded because it had a population of less than a million people in 2010).

[60] The authors present two sets of sector-specific PPPs. The first one is disaggregated at 35 industries and covers 42 countries. The second one is disaggregated at 10 sectors but includes a much wider set of countries. In particular, it covers all countries included in the PWT8 (147 countries).

[61] These are the cases of Brazil, China and India using the dataset of de Vries et al. (2012); and Ireland using the OECD STAN Database.

[62] China and Turkey were extended using two additional sources. In China the APO Database was used to extend the sectoral figures of 1987 (starting year of de Vries et al., 2012) up to 1978. In the case of Turkey the data collected in McMillan and Rodrik (2011) was used to extend the sectoral figures of 1995 up to 1988.

[63] Available at www.indec.mecon.ar, theme *Cuentas Nacionales: Cuentas Generación del Ingreso e Insumo de Mano de Obra*. See DNCN (2006) for the details.

[64] Available at http://www.bcentral.cl/publicaciones/estadisticas/actividad-economica-gasto/aeg01g.htm

2003-2010. The level of disaggregation in this dataset, however, did not match the 35-industries of Inklaar and Timmer (2012), and therefore it was further opened using secondary data sources.[65] The figures for employment at 10 sectors for the same period were obtained from BCC (2012).[66] The estimates of sectoral value added and employment in both countries were then regrouped into 10 sectors and back cast to 1950 using the data set provided in Timmer et al. (2014).

For the abovementioned countries (41 in total) our estimates have been carried out at 35-industries and then converted into 10 industries in order to cover a larger span on time. The remaining countries of our sample (59 countries) have been calculated directly at 10 sectors. That means that the benchmark levels for 2005 were calculated for the 10 sectors of Table 1 at LCU, then converted into international PPP dollars using the sectoral convertors (at the corresponding disaggregation) and then extrapolated as far as possible using the best available sources. In what follow we detail the sources used for each group of countries (this information is summarized in Table A-7).

In four countries (Israel, New Zealand, Norway and Switzerland) the data was taken from OECD-STAN Database. This source presents information on employment and value added (at current and constant prices) at a level of disaggregation that can be easily converted into our 10 sectors. The time coverage, however, is not homogeneous and ranges from 40 years in Norway to only 8 in Israel.

Three other sources that provide comparable data at sectoral level have been used extensively: the GGDC 10-Sector Database, the GGDC African Sector Database and the Asian Productivity Organization (APO) Database. Each of these sources present international comparable data on employment and value added disaggregated, at least, in the 10 broad sectors used here, for a very long span of time (starting on the 1950s, 1960s or 1970s depending on the country).[67] The series for 28 countries have been constructed using exclusively these three sources (see Table A-7).

The last 26 countries have been calculated using UNSTATS data for sectoral value added and ILO-KILM8 data for employment complemented with specific data from EUROSTATS and the UN regional economic commissions (ECLAC, ECA and ESCWA). In these cases, however, the time spam covered is significantly reduced due to lack of information, especially on employment by sector before the 1990s. Data for sectoral value added at constant 2005 LCU have been calculated using UNSD.

[65] Three sectoral aggregates within manufacturing needed to be opened further: *Textiles* (ISIC codes 17 to 19), *Chemistry* (ISIC codes 23 to 25) and *Machinery and Metal Products* (ISIC codes 28 to 37). For the figures at 2005 prices, sub-sector specific shares were calculated using average values from the national input outputs tables 2003 and 2008 (unfortunately there was not such information for 2005). For the constant figures, instead, the sub-sectoral shares of 2005 were extrapolated using ECLAC-PADI database.

[66] Available at http://www.bcentral.cl/publicaciones/estadisticas/informacion-integrada/iei14.htm

[67] The series of sectoral value added of the APO Database have been complemented with information from the United Nation Statistical Division (UNSD) in order to deduct sub-sector 70 (Real Estates) from sector K (Real Estates and Business Services). To do so, the sectoral share of sub-sector 70 in sector K at constant LCU of 2005 have been calculated using Tables 2.1 and 2.2 of UNSD National Accounts Official Country Data (available at data.un.org).

National Accounts Main Aggregates Database. This database provides information on sectoral value added at 2005 LCU for more than 200 countries between 1970 and 2012. The sectoral disaggregation, however, only distinguishes 7 sectors.[68] Thus, these sectoral aggregates have been further opened using sub-sectoral shares at 2005 prices specifically calculated using the data published by UNSD National Accounts Official Country Data (Tables 2.1 and 2.2). Given the shorter coverage (in time and across countries) of the latter, the number of countries and the period for which we could gather the necessary information has been significantly reduced. The main limitation for these countries, however, has been in terms of employment data disaggregated by sector. Our approach here was to use the best available information at major sectors (typically published by regional organization that publishes data for international comparisons at sub-regional levels) and open them using the data encompassed in ILO-KILM8 Database. The following table summarizes the four main sources used in this regard, the countries included and the sectoral disaggregation:

[68] These sectors are: *Agriculture, hunting, forestry, fishing* (ISIC AtB), *Mining, Manufacturing, Utilities* (ISIC CtE), *Manufacturing* (ISIC D), *Construction* (ISIC F), *Wholesale, retail trade, restaurants and hotels* (ISIC GtH), *Transport, storage and communication* (ISIC I) and *Other Activities* (ISIC JtP).

Table A-5. *Additional sources for sectoral employment*

Source	Countries	Period	Disaggregation
ADB (1)	*Azerbaijan, Georgia, Kazakhstan, Kyrgyz Republic*	*2000-2009*	*4 major sectors (Agriculture, Mining, Industry –exc. Mining– and Services)*
EUROSTATS: CPC and ENP (2)	*Croatia, Moldova, Macedonia, Serbia, Ukraine*	*2000-2009*	*4 major sectors (Agriculture, Industry –exc. Construction–, Construction and Services)*
EUROSTATS: MED (3)	*Morocco*	*2000-2009*	*8 sectors*
UN-ECA (4)	*Burkina Faso, Cameroon, Lesotho, Madagascar, Mali, Mozambique, Namibia, Niger, Rwanda, Sierra Leone, Togo, Uganda*	*1990-2004*	*3 major sectors (Agriculture, Industry and Services)*
UN-ECLAC (5)	*Ecuador and Uruguay*	*1990-2010*	*9 sectors*
UN-ESCWA (6)	*Jordan and Yemen*	*2005-2010*	*4 major sectors (Agriculture, Industry –exc. Construction–, Construction and Services)*

Notes:

(1) ADB, Key Indicators for Asia and the Pacific, various issues.

(2) EUROSTAT online, Non-EU Countries, Candidate countries and potential candidates (CPC) and Eastern European Neighbourhood Policy countries (ENP).

(3) EUROSTAT online, Non-EU Countries, Southern European Neighbourhood Policy countries (MED).

(4) Refers to UNECA (2005)

(5) ECLAC STATS online.

(6) ESCWA, Statistical Abstract of the West Africa Region, various issues.

Employment figures by major sectors were then decomposed further using specific employment shares of the constitutive sub-sectors calculated from the ILO-KILM8 Database. In some cases (EUROSTAT for CPC and ENP countries and UN-ECA) the original source did not provide any estimate for the total number of workers and, therefore, total employment was taken from Penn World Tables 8[69], and then opened by sector using the corresponding shares.

In Table A-7 we provide the details of the specific source used by country and years to construct our figures of sectoral employment and value added.

10.3. Unemployment

The figures of unemployment have been estimated separately for three board groups of countries: 1) OECD countries (excluding Chile and Mexico); 2) Latin American countries; and 3) Non-OECD Asian and African countries.

[69] Available at www.ggdc.net/pwt. See Feenstra et al. (2013) for the methodological details.

In the first set of countries (OECD) all data has been collected from OECD.stats, which provides estimates of unemployment rates for all OECD countries starting in the year 1955.[70]

For the Latin American countries our main data source has been Ball et al. (2012). These authors provide very long series of (relatively) comparable unemployment rates, covering (depending of the country) the period 1960-2013. In order to expand the time span covered across countries by these series, additional sources have been used. Table A-8 specifies these sources and the years for which they provide information. Our final figures result from the extrapolation of the unemployment rates estimated in Ball et al. (2012) using these additional sources. In those cases in which there were no data for a linking year between sources, the values of unemployment rates as published in the original sources have been used (unless they were extremely different from the first year with available information in Ball et al., 2012).

In the remaining countries the main data source was ILO KILM8 Dataset. This source provides estimates built by the organization (that are harmonized in order to be internationally comparable) for the period 1991-2010 for all countries in our sample. It also provides information (not harmonized) for a longer period of time, typically starting in the 1980s, coming from the national statistical offices. On the other hand, ILO LABORSTA Database also contains data coming from national household surveys and population census starting in the early 1960s. Using these sources and a series of historical paper that have specifically dealt with this issue we have calculated growth figures for the unemployment rates and back cast the ILO estimates to cover as many years as possible. In Table A-9 we specify the sources used in each country and period.

As we have previously mentioned, however, in many of these countries the constructed series of unemployment rates cover a shorter period than our estimates for sectoral employment and value added. In those cases, the unemployed population has been back cast using the growth rates of total employment, under the implicit assumption that the unemployment rates have not changed significantly during these years.

[70] Available at stats.oecd.org, Annual Labour Force Statistics (ALFS).

10.4. Sources used and period covered

Table A-6. *Sources used and period covered by country: Per capita GNI*

id	*Country*	Coverage	WDI	TED		PWT8	MPD	WEOD
ARG	Argentina	(1950-2013)	(1960-2006)	(1950-1959)	(2007-2013)			
AUS	Australia	(1950-2013)	(1960-2012)	(1950-1959)	(2013-2013)			
AUT	Austria	(1950-2013)	(1960-2012)	(1950-1959)	(2013-2013)			
AZE	Azerbaijan	(1980-2013)	(1994-2012)	(1980-1993)	(2013-2013)			
BEL	Belgium	(1950-2013)	(1960-2012)	(1950-1959)	(2013-2013)			
BFA	Burkina Faso	(1950-2013)	(1965-2011)	(1950-1964)	(2012-2013)			
BGD	Bangladesh	(1950-2013)	(1973-2012)	(1950-1972)	(2013-2013)			
BGR	Bulgaria	(1950-2013)	(1980-2012)	(1950-1979)	(2013-2013)			
BOL	Bolivia	(1950-2013)	(1970-2012)	(1950-1969)	(2013-2013)			
BRA	Brazil	(1950-2013)	(1960-2012)	(1950-1959)	(2013-2013)			
BWA	Botswana	(1950-2013)	(1975-2012)			(1960-1974)	(1950-1959)	(2013-2013)
CAN	Canada	(1950-2013)	(1960-2012)	(1950-1959)	(2013-2013)			
CHE	Switzerland	(1950-2013)	(1980-2012)	(1950-1979)	(2013-2013)			
CHL	Chile	(1950-2013)	(1960-2012)	(1950-1959)	(2013-2013)			
CHN	China	(1950-2013)	(1978-2012)	(1950-1977)	(2013-2013)			
CMR	Cameroon	(1950-2013)	(1967-2012)	(1950-1966)	(2013-2013)			
COL	Colombia	(1950-2013)	(1960-2012)	(1950-1959)	(2013-2013)			
CRI	Costa Rica	(1950-2013)	(1960-2012)	(1950-1959)	(2013-2013)			
CYP	Cyprus	(1950-2013)	(1975-2010)	(1950-1974)	(2011-2013)			
CZE	Czech Republic	(1985-2013)	(1992-2012)	(1985-1991)	(2013-2013)			
DEU	Germany	(1950-2013)	(1970-2012)	(1950-1969)	(2013-2013)			
DNK	Denmark	(1950-2013)	(1970-2012)	(1950-1969)	(2013-2013)			
ECU	Ecuador	(1950-2013)	(1960-2012)	(1950-1959)	(2013-2013)			
EGY	Egypt	(1950-2013)	(1965-2012)	(1950-1964)	(2013-2013)			
ESP	Spain	(1950-2013)	(1960-2012)	(1950-1959)	(2013-2013)			
EST	Estonia	(1980-2013)	(1995-2012)	(1980-1994)	(2013-2013)			
ETH	Ethiopia	(1950-2013)	(1981-2012)	(1950-1980)	(2013-2013)			
FIN	Finland	(1950-2013)	(1960-2012)	(1950-1959)	(2013-2013)			
FRA	France	(1950-2013)	(1960-2012)	(1950-1959)	(2013-2013)			
GBR	United Kingdom	(1950-2013)	(1970-2012)	(1950-1969)	(2013-2013)			
GEO	Georgia	(1980-2013)	(2005-2005)	(1980-2004)	(2006-2013)			
GHA	Ghana	(1950-2013)	(2005-2005)	(1950-2004)	(2006-2013)			
GRC	Greece	(1950-2013)	(1960-2012)	(1950-1959)	(2013-2013)			
HKG	Hong Kong	(1950-2013)	(1999-2012)	(1950-1998)	(2013-2013)			
HRV	Croatia	(1952-2013)	(1995-2012)	(1980-1994)	(2013-2013)		(1952-1979)	
HUN	Hungary	(1950-2013)	(1960-2010)	(1951-1959)	(2011-2013)		(1950-1950)	
IDN	Indonesia	(1950-2013)	(1960-2012)	(1950-1959)	(2013-2013)			
IND	India	(1950-2013)	(1960-2012)	(1950-1959)	(2013-2013)			
IRL	Ireland	(1950-2013)	(2000-2012)	(1950-1999)	(2013-2013)			
IRN	Iran	(1950-2013)	(1965-2007)	(1950-1964)	(2008-2013)			
ISR	Israel	(1950-2013)	(1995-2011)	(1950-1994)	(2012-2013)			
ITA	Italy	(1950-2013)	(1960-2012)	(1950-1959)	(2013-2013)			
JOR	Jordan	(1950-2013)	(1976-2012)	(1950-1975)	(2013-2013)			
JPN	Japan	(1950-2013)	(1960-2012)	(1950-1959)	(2013-2013)			
KAZ	Kazakhstan	(1980-2013)	(1993-2012)	(1980-1992)	(2013-2013)			
KEN	Kenya	(1950-2013)	(1960-2012)	(1950-1959)	(2013-2013)			
KGZ	Kyrgyz Republic	(1980-2013)	(1992-2012)	(1980-1991)	(2013-2013)			
KHM	Cambodia	(1950-2013)	(1995-2011)	(1950-1994)	(2012-2013)			
KOR	Korea	(1950-2013)	(1960-2012)	(1950-1959)	(2013-2013)			
LKA	Sri Lanka	(1950-2013)	(1980-2012)	(1950-1979)	(2013-2013)			

Table A-6. *Sources used and period covered by country: Per capita GNI* (cont.)

id	*Country*	Coverage	WDI	TED		PWT8	MPD	WEOD
LSO	Lesotho	(1950-2013)	(1966-2012)			(1960-1965)	(1950-1959)	(2013-2013)
LTU	Lithuania	(1980-2013)	(2005-2005)	(1980-2004)	(2006-2013)			
LVA	Latvia	(1980-2013)	(1991-2010)	(1980-1990)	(2011-2013)			
MAR	Morocco	(1950-2013)	(1965-2012)	(1950-1964)	(2013-2013)			
MDA	Moldova	(1980-2013)	(1992-2012)	(1980-1991)	(2013-2013)			
MDG	Madagascar	(1950-2013)	(1960-2009)	(1950-1959)	(2010-2013)			
MEX	Mexico	(1950-2013)	(1960-2012)	(1950-1959)	(2013-2013)			
MKD	Macedonia	(1952-2013)	(1990-2012)	(1980-1989)	(2013-2013)		(1952-1979)	
MLI	Mali	(1950-2013)	(1980-2007)	(1950-1979)	(2008-2013)			
MNG	Mongolia	(1950-2013)	(2005-2012)			(1970-2004)	(1950-1969)	(2013-2013)
MOZ	Mozambique	(1950-2013)	(1980-2012)	(1950-1979)	(2013-2013)			
MUS	Mauritius	(1950-2013)	(1976-2012)			(1960-1975)	(1950-1959)	(2013-2013)
MWI	Malawi	(1950-2013)	(2003-2011)	(1950-2002)	(2012-2013)			
MYS	Malaysia	(1950-2013)	(1960-2012)	(1950-1959)	(2013-2013)			
NAM	Namibia	(1950-2013)	(1980-2012)			(1960-1979)	(1950-1959)	(2013-2013)
NER	Niger	(1950-2013)	(2005-2005)	(1950-2004)	(2006-2013)			
NGA	Nigeria	(1950-2013)	(1981-2012)	(1950-1980)	(2013-2013)			
NLD	Netherlands	(1950-2013)	(1960-2012)	(1950-1959)	(2013-2013)			
NOR	Norway	(1950-2013)	(1960-2012)	(1950-1959)	(2013-2013)			
NPL	Nepal	(1950-2013)	(2001-2012)			(1960-2000)	(1950-1959)	(2013-2013)
NZL	New Zealand	(1950-2013)	(1977-2011)	(1950-1976)	(2012-2013)			
PAK	Pakistan	(1950-2013)	(1967-2012)	(1950-1966)	(2013-2013)			
PER	Peru	(1950-2013)	(1960-2012)	(1950-1959)	(2013-2013)			
PHL	Philippines	(1950-2013)	(1960-2012)	(1950-1959)	(2013-2013)			
POL	Poland	(1950-2013)	(1991-2012)	(1950-1990)	(2013-2013)			
PRT	Portugal	(1950-2013)	(1960-2012)	(1950-1959)	(2013-2013)			
ROM	Romania	(1950-2013)	(1990-2012)	(1950-1989)	(2013-2013)			
RUS	Russia	(1980-2013)	(1990-2012)	(1980-1989)	(2013-2013)			
RWA	Rwanda	(1950-2013)	(1970-2012)			(1960-1969)	(1950-1959)	(2013-2013)
SEN	Senegal	(1950-2013)	(1968-2012)	(1950-1967)	(2013-2013)			
SGP	Singapore	(1950-2013)	(1975-2012)	(1950-1974)	(2013-2013)			
SLE	Sierra Leone	(1950-2013)	(1967-2011)			(1961-1966)	(1950-1960)	(2012-2013)
SRB	Serbia	(1952-2013)	(1999-2011)			(1990-1998)	(1952-1989)	(2012-2013)
SVK	Slovak Republic	(1985-2013)	(1992-2010)	(1985-1991)	(2011-2013)			
SVN	Slovenia	(1952-2013)	(1992-2010)	(1980-1991)	(2011-2013)		(1952-1979)	
SWE	Sweden	(1950-2013)	(1960-2012)	(1950-1959)	(2013-2013)			
TGO	Togo	(1950-2013)	(1960-2011)				(1950-1959)	(2012-2013)
THA	Thailand	(1950-2013)	(1965-2012)	(1950-1964)	(2013-2013)			
TUR	Turkey	(1950-2013)	(1987-2012)	(1950-1986)	(2013-2013)			
TWN	Taiwan	(1950-2013)		(1950-1959)	(2012-2013)	(1960-2011)		
TZA	Tanzania	(1950-2013)	(1990-2012)	(1950-1989)	(2013-2013)			
UGA	Uganda	(1950-2013)	(1982-2011)	(1950-1981)	(2012-2013)			
UKR	Ukraine	(1980-2013)	(1990-2012)	(1980-1989)	(2013-2013)			
URY	Uruguay	(1950-2013)	(1960-2012)	(1950-1959)	(2013-2013)			
USA	United States	(1950-2013)	(1970-2012)	(1950-1969)	(2013-2013)			
VEN	Venezuela	(1950-2013)	(1974-2012)	(1950-1973)	(2013-2013)			
VNM	Vietnam	(1950-2013)	(1989-2012)	(1950-1988)	(2013-2013)			
YEM	Yemen	(1950-2013)	(1990-2010)	(1950-1989)	(2011-2013)			
ZAF	South Africa	(1950-2013)	(1960-2012)	(1950-1959)	(2013-2013)			
ZMB	Zambia	(1950-2013)	(1960-2011)	(1950-1959)	(2012-2013)			

Table A-7. *Sources used and period covered by country: Sectoral Employment and Value Added*

id	Country	Coverage	WIOD	KLEMS	STAN	GGDC10s	APO	OTHERS	
ARG	*Argentina*	(1950-2009)				(1950-1992)		(1993-2009)	(5)
AUS	*Australia*	(1970-2009)	(1995-2009)	(1970-1994)					
AUT	*Austria*	(1970-2009)	(1995-2009)	(1970-1994)					
AZE	*Azerbaijan*	(2001-2009)						(2001-2009)	(1)
BEL	*Belgium*	(1970-2009)	(1995-2009)	(1970-1994)					
BFA	*Burkina Faso*	(2002-2005)						(2002-2005)	(6)
BGD	*Bangladesh*	(1973-2007)					(1973-2007)		
BGR	*Bulgaria*	(1995-2009)	(1995-2009)						
BOL	*Bolivia*	(1950-2009)				(1950-2009)			
BRA	*Brazil*	(1950-2009)	(1995-2009)			(1950-1980)		(1980-1994)	(2)
BWA	*Botswana*	(1968-2009)				(1968-2009)			
CAN	*Canada*	(1961-2009)	(1995-2009)			(1961-1994)			
CHE	*Switzerland*	(1991-2008)			(1991-2008)				
CHL	*Chile*	(1950-2009)				(1950-2002)		(2003-2009)	(5)
CHN	*China*	(1950-2009)	(1995-2009)			(1950-1986)		(1987-1994)	(2)
CMR	*Cameroon*	(1996-2005)						(1996-2005)	(6)
COL	*Colombia*	(1950-2009)				(1950-2009)			
CRI	*Costa Rica*	(1950-2009)				(1950-2009)			
CYP	*Cyprus*	(1995-2009)	(1995-2009)						
CZE	*Czech Republic*	(1995-2009)	(1995-2009)						
DEU	*Germany*	(1970-2009)	(1995-2009)	(1970-1994)					
DNK	*Denmark*	(1950-2009)	(1995-2009)	(1970-1994)		(1950-1970)			
ECU	*Ecuador*	(1990-2009)						(1990-2009)	(7)
EGY	*Egypt*	(1960-2009)				(1960-2009)			
ESP	*Spain*	(1950-2009)	(1995-2009)	(1970-1994)		(1950-1970)			
EST	*Estonia*	(1995-2009)	(1995-2009)						
ETH	*Ethiopia*	(1961-2009)				(1961-2009)			
FIN	*Finland*	(1970-2009)	(1995-2009)	(1970-1994)					
FRA	*France*	(1950-2009)	(1995-2009)	(1970-1994)		(1950-1970)			
GBR	*United Kingdom*	(1950-2009)	(1995-2009)	(1970-1994)		(1950-1970)			
GEO	*Georgia*	(1998-2007)						(1998-2007)	(1)
GHA	*Ghana*	(1960-2009)				(1960-2009)			
GRC	*Greece*	(1970-2009)	(1995-2009)	(1970-1994)					
HKG	*Hong Kong*	(1974-2005)				(1974-2005)			
HRV	*Croatia*	(1996-2007)						(1996-2007)	(3)
HUN	*Hungary*	(1992-2009)	(1995-2009)	(1992-1994)					
IDN	*Indonesia*	(1971-2009)	(1995-2009)			(1971-1994)			
IND	*India*	(1960-2009)	(1995-2009)			(1960-1980)		(1980-1994)	(2)
IRL	*Ireland*	(1970-2009)	(1995-2009)		(1970-1994)				
IRN	*Iran*	(1973-2007)					(1973-2007)		
ISR	*Israel*	(2000-2008)			(2000-2008)				
ITA	*Italy*	(1951-2009)	(1995-2009)	(1970-1994)		(1951-1970)			
JOR	*Jordan*	(2000-2009)						(2000-2009)	(8)
JPN	*Japan*	(1953-2009)	(1995-2009)	(1970-1994)		(1953-1970)			
KAZ	*Kazakhstan*	(1999-2009)						(1999-2009)	(1)
KEN	*Kenya*	(1969-2009)				(1969-2009)			
KGZ	*Kyrgyz Republic*	(2000-2008)						(2000-2008)	(1)
KHM	*Cambodia*	(1993-2007)					(1993-2007)		
KOR	*Korea*	(1963-2009)	(1995-2009)	(1970-1994)		(1963-1970)			
LKA	*Sri Lanka*	(1971-2007)					(1971-2007)		
LSO	*Lesotho*	(1990-2005)						(1990-2005)	(6)
LTU	*Lithuania*	(1995-2009)	(1995-2009)						
LVA	*Latvia*	(1995-2009)	(1995-2009)						
MAR	*Morocco*	(1960-2009)				(1960-2009)			
MDA	*Moldova*	(1999-2008)						(1999-2008)	(3)

Table A-7. *Sources used and period covered by country: Sectoral Employment and Value Added* (Cont.)

id	Country	Coverage	WIOD	KLEMS	STAN	GGDC10s	APO	OTHERS	
MDG	Madagascar	(2005-2005)						(2005-2005)	(6)
MEX	Mexico	(1950-2009)	(1995-2009)			(1950-1994)			
MKD	Macedonia	(1997-2009)						(1997-2009)	(3)
MLI	Mali	(2005-2005)						(2005-2005)	(6)
MNG	Mongolia	(1970-2007)					(1970-2007)		
MOZ	Mozambique	(1995-2005)						(1995-2005)	(6)
MUS	Mauritius	(1970-2009)				(1970-2009)			
MWI	Malawi	(1966-2009)				(1966-2009)			
MYS	Malaysia	(1975-2005)				(1975-2005)			
NAM	Namibia	(1993-2005)						(1993-2005)	(6)
NER	Niger	(2005-2005)						(2005-2005)	(6)
NGA	Nigeria	(1960-2009)				(1960-2009)			
NLD	Netherlands	(1950-2009)	(1995-2009)	(1970-1994)		(1950-1970)			
NOR	Norway	(1970-2009)			(1970-2009)				
NPL	Nepal	(1984-2007)					(1984-2007)		
NZL	New Zealand	(1989-2006)			(1989-2006)				
PAK	Pakistan	(1970-2007)					(1970-2007)		
PER	Peru	(1960-2009)				(1960-2009)			
PHL	Philippines	(1971-2009)				(1971-2009)			
POL	Poland	(1995-2009)	(1995-2009)						
PRT	Portugal	(1970-2009)	(1995-2009)	(1970-1994)					
ROM	Romania	(1995-2009)	(1995-2009)						
RUS	Russia	(1995-2009)	(1995-2009)						
RWA	Rwanda	(1990-2005)						(1990-2005)	(6)
SEN	Senegal	(1970-2009)				(1970-2009)			
SGP	Singapore	(1970-2009)				(1970-2009)			
SLE	Sierra Leone	(2005-2005)						(2005-2005)	(6)
SRB	Serbia	(2004-2009)						(2004-2009)	(3)
SVK	Slovak Republic	(1995-2009)	(1995-2009)						
SVN	Slovenia	(1995-2009)	(1995-2009)						
SWE	Sweden	(1950-2009)	(1995-2009)	(1970-1994)		(1950-1970)			
TGO	Togo	(2005-2006)						(2005-2006)	(6)
THA	Thailand	(1960-2009)				(1960-2009)			
TUR	Turkey	(1988-2009)	(1995-2009)					(1988-1994)	(4)
TWN	Taiwan	(1963-2009)	(1995-2009)	(1970-1994)		(1963-1970)			
TZA	Tanzania	(1960-2009)				(1960-2009)			
UGA	Uganda	(2000-2005)						(2000-2005)	(6)
UKR	Ukraine	(2001-2009)						(2001-2009)	(3)
URY	Uruguay	(1990-2009)						(1990-2009)	(7)
USA	United States	(1950-2009)	(1995-2009)	(1950-1994)		(1950-1950)			
VEN	Venezuela	(1950-2009)				(1950-2009)			
VNM	Vietnam	(1990-2007)					(1990-2004)	(2005-2007)	(5)
YEM	Yemen	(1994-2009)						(1994-2009)	(8)
ZAF	South Africa	(1960-2009)				(1960-2009)			
ZMB	Zambia	(1965-2009)				(1965-2009)			

Note: The source "Others" refers to: (1) ADB KIAP Database; (2) de Vries et al. (2012); (3) EUROSTAT; (4) McMillan and Rodrik (2011); (5) National Statistics Institute (NIS); (6) UN-ECA; (7) CEPALSTAT; (8) UN-ESCWA. In all cases, except (2), (4) and (5), these sources have been complemented with data from UNSD and KILM8 Database.

Table A-8. *Sources used and period covered by country (Latin American countries): Unemployment rate*

id	Country	Coverage	Ball et al. (2012)	ECLAC (1986)	PREALC (1982)	CEPALSTAT	Others	
ARG	Argentina	(1963-2009)	(1970-2009)		(1963-1969)			
BOL	Bolivia	(1976-2011)	(1989-2011)	(1978-1980)	(1976-1977)	(1981-1988)	(1972-1975)	(2)
BRA	Brazil	(1978-2009)	(1982-2009)	(1978-1991)				
CHL	Chile	(1957-2009)	(1957-2009)					
COL	Colombia	(1963-2009)	(1975-2009)		(1970-1974)		(1963-1969)	(1)
CRI	Costa Rica	(1966-2009)	(1976-2009)	(1970)	(1967-1969)		(1963-1966)	(3)
ECU	Ecuador	(1975-2009)	(1990-2009)		(1975)	(1980-1989)		
MEX	Mexico	(1963-2009)	(1973-2009)	(1970)			(1963)	(3)
PER	Peru	(1968-2009)	(1970-2009)		(1969)		(1968)	(1)
URY	Uruguay	(1967-2009)	(1968-2009)		(1967)			
VEN	Venezuela	(1967-2009)	(1967-2009)					

Note: The source "Others" refers to: (1) Morawetz (1977); (2) ILO Labour Statistics Yearbook, Various Issues; (3) Turnham (1971).

Table A-9. *Sources used and period covered by country (non-OECD, Asian and African countries): Unemployment rate*

id	Country	Coverage	KILM8 (ILO est)	KILM8 (NAC est)	LABORSTA	Morawetz (1977)	Vandemoortele (1991)	Turnham and Eröcal (1990)	Others	
AZE	Azerbaijan	(1991-2009)	(1991-2009)							
BFA	Burkina Faso	(1991-2009)	(1991-2009)							
BGD	Bangladesh	(1984-2009)	(1991-2009)	(1984-1990)						
BGR	Bulgaria	(1991-2009)	(1991-2009)							
BWA	Botswana	(1985-2009)	(1991-2009)	(1985-1990)						
CHN	China	(1978-2009)	(1991-2009)	(1980-1990)	(1978-1979)					
CMR	Cameroon	(1991-2009)	(1991-2009)							
EGY	Egypt	(1970-2009)	(1991-2009)	(1980-1990)	(1970-1979)					
ETH	Ethiopia	(1984-2009)	(1991-2009)	(1984-1990)						
GEO	Georgia	(1991-2009)	(1991-2009)							
GHA	Ghana	(1970-2009)	(1991-2009)			(1970-1970)	(1987-1987)			
HUN	Hungary	(1991-2009)	(1991-2009)							
IDN	Indonesia	(1971-2009)	(1991-2009)					(1986-1986)	(1971-1971)	(2)
IND	India	(1959-2009)	(1991-2009)			(1971-1971)			(1959-1961)	(5)
IRN	Iran	(1986-2009)	(1991-2009)	(1986-1990)						
JOR	Jordan	(1991-2009)	(1991-2009)							
KAZ	Kazakhstan	(1991-2009)	(1991-2009)							
KEN	Kenya	(1978-2009)	(1991-2009)				(1978-1978)			
KGZ	Kyrgyz Republic	(1991-2009)	(1991-2009)							
KHM	Cambodia	(1991-2009)	(1991-2009)							
LKA	Sri Lanka	(1970-2009)	(1991-2009)	(1985-1990)					(1970-1981)	(3)
LSO	Lesotho	(1991-2009)	(1991-2009)							
MAR	Morocco	(1987-2009)	(1991-2009)	(1987-1990)						
MDA	Moldova	(1991-2009)	(1991-2009)							
MDG	Madagascar	(1991-2009)	(1991-2009)							
MKD	Macedonia	(1991-2009)	(1991-2009)							
MLI	Mali	(1991-2009)	(1991-2009)							
MNG	Mongolia	(1991-2009)	(1991-2009)							
MOZ	Mozambique	(1991-2009)	(1991-2009)							
MUS	Mauritius	(1991-2009)	(1991-2009)							
MWI	Malawi	(1983-2009)	(1991-2009)	(1983-1990)						
MYS	Malaysia	(1975-2009)	(1991-2009)	(1982-1990)				(1975-1985)		
NAM	Namibia	(1991-2009)	(1991-2009)							
NER	Niger	(1991-2009)	(1991-2009)							
NGA	Nigeria	(1974-2009)	(1991-2009)				(1974-1983)	(1984-1988)		
NPL	Nepal	(1991-2009)	(1991-2009)							
PAK	Pakistan	(1970-2009)	(1991-2009)					(1970-1986)		
PHL	Philippines	(1970-2009)	(1991-2009)	(1980-1990)	(1970-1979)					
ROM	Romania	(1991-2009)	(1991-2009)							
RWA	Rwanda	(1991-2009)	(1991-2009)							
SEN	Senegal	(1970-2009)	(1991-2009)				(1985-1985)		(1970-1980)	(4)
SLE	Sierra Leone	(1991-2009)	(1991-2009)							
SRB	Serbia	(1991-2009)	(1991-2009)							
TGO	Togo	(1991-2009)	(1991-2009)							
THA	Thailand	(1969-2009)	(1991-2009)	(1980-1990)	(1971-1979)	(1969-1969)		(1970-1986)		
TUR	Turkey	(1988-2009)	(1991-2009)		(1988-1990)					
TZA	Tanzania	(1965-2009)	(1991-2009)			(1971-1971)			(1965-1965)	(5)
UGA	Uganda	(1991-2009)	(1991-2009)							
UKR	Ukraine	(1991-2009)	(1991-2009)							
VNM	Vietnam	(1991-2009)	(1991-2009)							
YEM	Yemen	(1991-2009)	(1991-2009)							
ZAF	South Africa	(1960-2009)	(1991-2009)						(1960-1982)	(1)
ZMB	Zambia	(1986-2009)	(1991-2009)	(1986-1990)						

Note: The source "Others" refers to: (1) Bell (1984); (2) Krueger (1983); (3) Nanayakkara (2004); (4) Terrell and Svejnar (1990); (5) Turnham (1971).

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