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Abstract

Against what theory predicts, large productivity gaps across sectors persist and the process of structural transformation is stagnant in many developing economies. This wedge between observed and optimal labor allocations suggests the presence of institutional and market frictions, which impose costs on the reallocation of labor from low to high productivity sectors, thus leading to sub-optimal allocations and a loss in aggregate labor productivity. Using a panel of crosscountry sector-level data, we estimate a dynamic panel error correction model that captures the dynamic adjustment of labor flows across sectors. We find that, on average, labor flows from low to high productivity sectors, closing around 15.4 percent of labor productivity gaps each year. The pace of this flow varies across country income groups and geographical regions, with high-income countries enjoying a more fluid structural transformation process than lower income countries. Heterogeneity also arises across sectors, suggesting a positive role for sectoral policies. With regard to labor market regulations, we find a significant positive association between the pace of labor reallocation across sectors and the freedom level of labor market institutions. However, in contrast to neo-classical intuition, we find that lowering firing costs slows the structural transformation process. Results suggest that the discouraging effect of having lower job security on the labor supply side is stronger than the benefits that firms gain from more flexible labor market conditions. Hence, policy reforms need to steer between the goal of easing job creation and destruction, while supporting labor supply incentives to reallocate and shift industries through strong social nets, labor protection, and risk sharing.

Keywords: Labor misallocation, labor reforms; structural transformation; multi-sectors growth models; Error Correction Models.

JEL Classifications: O41, O47, C23.

1 Introduction

Cross-country studies reveal a large gap in aggregate labor productivity levels between countries at the opposite ends of income distribution (Caselli (2005) and Erosa, Koreshkova, and Restuccia (2010)). In a multi-sector economy, two factors determine aggregate labor productivity: within sector productivity and the allocation efficiency of resources across these sectors. Empirical work shows that countries struggling with low aggregate productivity levels lag in both respects; first, levels of sectoral labor productivity differ widely across countries in favor of developed economies, with the differences being largest in the agriculture and services sectors, but smaller in manufacturing (Duarte and Restuccia (2010), Gollin, Lagakos, and Waugh (2014)); second, there are larger discrepancies in labor productivity levels across sectors within less developed countries (McMillan and Rodrik (2011)). [1]

In this paper, we focus on the *across*-sector allocation efficiency as a determinant of aggregate labor productivity.[2] Theory postulates that the process of structural transformation within a country, whereby labor moves from low to high labor productivity sectors, should be immediate and continue until productivity gaps across sectors cease to exist (e.g. Laitner (2000), Ngai and Pissarides (2007)). However, against this prediction, large productivity gaps across sectors persist in most economies, suggesting the presence of frictions that impede the immediate flow of labor toward its efficient allocation. In this context, job flows across sectors are only partial and incomplete. The first goal of this paper is to quantify the magnitude of these frictions as implied by the pace by which jobs flow toward their optimal allocations.

The second goal is to evaluate the contribution of labor market regulations to these frictions. That is, we explore whether variations across countries with respect to the tightness of their labor market regulations could explain the heterogeneity observed among them with respect to the persistence of across-sector productivity gaps. Economies facing lower frictions enjoy more dynamic labor mobility and react faster to shifts in the drivers of the structural transformation process, making productivity gaps less persistent. On the other hand, excessive labor regulations make hiring and firing costly for firms, discouraging, in return, both job destruction in lower productivity occupations and job creation in higher productivity ones . These rigidities inhibit the efficient flow of jobs across sectors and result in inefficient allocations of employment shares and lost opportunities for productivity growth.

Understanding the obstacles to an efficient structural transformation is particularly valuable for developing economies, which have set in place ambitious sectoral policies designed to boost potential growth, but where productivity and employment outcomes continue to lag. McMillan and Harttgen

[1] Taking Egypt as an example, the value added per employee (a measure of labor productivity) in the agriculture sector in 2005 was 14.1 (constant USD), compared to 39.34 in France. In addition, the ratio between labor productivity in manufacturing to agriculture was 2.74 in Egypt compared to 1.57 in France.

[2] The observed difference in labor productivity of the same sectors across different countries has received ample attention (Hsieh and Klenow (2009)).

(2014) show that between 2000 and 2010, structural transformation toward high productivity sectors accounted for roughly half of Africa's growth in output per worker.

To meet these goals, we estimate a dynamic panel error correction model (P-ECM) of sectoral labor allocation using sector level data for a panel of 44 countries covering developed, emerging, and frontier economies. The choice of the model is motivated by the observation that the process of structural transformation is non-stationary, where value added and employment shares are *cointegrated*, being driven by the same underlying process of technical change (i.e. changes in sector level TFP) or income growth (Herrendorf, Rogerson, and Valentinyi (2013), Ngai and Pissarides (2007), Laitner (2000)). The P-ECM model is able to capture these key empirical patterns, while providing a measure of the level of policy distortions or institutional costs that restrict the fluidity of labor reallocation (i.e. speed of adjustment,Pagan (1985), Alogoskoufis and Smith (1991)). These distortions cause short term gaps (i.e. errors) in labor productivity across sectors by slowing down the efficient adjustment of employment shares in reaction to changes in aggregate income growth or sector level TFP.

The paper's contribution to the literature is twofold. First, it documents a new set of stylized facts with regards to the structural transformation process; we find empirical evidence that labor allocation (i.e. employment shares) across sectors follows an adjustment process, converging toward equilibrium allocations and closing around 15.4 % of labor productivity gaps each year over the full sample, on average. The rate of labor flow varies across country income groups and regions, with higher income countries enjoying more fluid structural transformation processes than lower income countries. In addition to income, we also find heterogeneity with respect to geographical regions, where Asia appears to have been the fastest transforming region, followed by Latin America, Europe-USA, and, finally, Africa. This is consistent with the large structural transformation wave that took place in these faster regions in the second half of the twentieth century, compared to the western countries that experienced their main wave in the 19^{th} and 18^{th} centuries, and African countries that are yet to undergo a major transformation. Moreover, we find that the rate of labor flows varies across sectors, implying different degrees of frictions among them and indicating a role for sectoral policies.

With regard to labor market regulations, we find a significant positive association between the pace of labor reallocation across sectors and the freedom level of labor market institutions. However, in contrast to the classical intuition, we find that lowering firing costs slows down the structural transformation process. This result suggests that the discouraging effect of having lower job security on the labor supply side is stronger than the benefits that firms gain from more flexible labor market conditions. Looking at the heterogeneity at the country income level, we find that for low income countries, higher levels of average labor costs, average employee payroll taxes, and minimum to mean wage ratios are associated with a slower flow of labor across sectors. For high income countries, the effect is insignificant, which implies that the effect of labor regulations on the process of structural transformation is more binding for less developed economies.

Given this set of results, we argue that there is space for policy reforms in labor markets to provide higher levels of aggregate labor productivity growth. However, policy reforms aiming at improving the fluidity of structural transformation need to maneuver between the goal of easing job creation and destruction, while supporting labor supply incentives to reallocate and shift industries through strong social nets, labor protection, and risk sharing. The remainder of the paper proceeds as follows: Section 2 reviews existing literature related to structural transformation and constraints to labor reallocation; section 3 describes the data; section 4 carries out a decomposition analysis to quantify the role of across-sector labor reallocation in aggregate productivity growth. Section 5 discusses our data and empirical strategy; Section 6 discusses our results; finally, section 7 concludes.

2 Literature Review

A large literature discusses the employment and participation rates effects of labor market regulations, including labor cost, employee payroll taxes, and other welfare measures such minimum wages and unemployment benefits (Siebert (1997)). The general agreement that comes out of the literature is that higher employment costs and less flexible regulations contribute to higher unemployment rates, where this line of argument is typically taken to justify the differences in employment levels between the United States and European economies. In this paper, we are more concerned with allocation efficiency; that is, we want to understand to the effect of labor market regulations on job flows across sectors. The answer to this question is less salient in the literature.

The efficient allocation of resources within a country can help close the gap between sectoral labor productivity levels within a country and raise aggregate productivity levels. Krugman (1994) provides a less formal presentation of this intuition for the case of China and the Soviet Union, where he argues that the significant rise in their productivity levels stem from massive reallocation of factor inputs toward higher productivity sectors, without necessarily raising sectoral TFP and efficiency levels. Restuccia and Rogerson (2008) analyze the relationship between allocative efficiency among firms and aggregate TFP. Their theoretical framework shows how frictions lead to a misallocation of resources and a decline in aggregate TFP; that is, frictions lead markets to allocate firms a disproportionate share of resources relative to their labor productivity. Hsieh and Klenow (2009), applying this intuition to Chinese and Indian industrial firms, find large hypothetical gains in productivity stemming from redistributing capital and labor resources such that marginal returns among firms are matched to levels observed in the US. The key contribution of these papers is to analyze the role frictions play in misallocation of resources and its impact on sectoral productivity.

Against this background, several papers try to identify the key frictions that drive labor and capital misallocations. Most of this work focuses on the firm-level. Haltiwanger, Scarpetta, and Schweiger (2014), using a large sample of Eastern European firms, find a statistically significant role for distortionary labor market regulations in hindering efficient labor allocations. Bai, Carvalho, and Phillips (2015), assessing the role of credit frictions across the US, find a positive significant effect of banking deregulation on the efficiency of labor reallocation across firms. Trade costs are another

source of distortions that allow less productive firms to survive, while high productivity firms suffer costly access to local markets. Costinot and Donaldson (2012) examine the empirical relevance of this intuition within the agricultural sector to test Ricardo's theory on comparative advantage.

In addition to capital and labor adjustment costs and financial and trade frictions, another set of frictions are more likely found in countries with less-developed institutions. For one, the presence of large state-owned enterprises (SOEs) can be a source of distortion. Subsidizing large and inefficient firms can drive resources away from more productive entities, as argued in Hsieh and Klenow (2009) for the case of India. The spread of an informal sector can also give rise to another source of distortions: in a study on Indian and Mexican firms, Hsieh and Klenow (2014) observe that manufacturing firms do not grow at the same speed observed in the US; Mexican and Indian firms tend to prefer to operate in the informal sector to avoid rigidities in the regulatory framework, but suffer lower productivity in return. At the sectoral level, McMillan and Rodrik (2011) highlight several sector-level frictions: (1) customs on imported goods protect less efficient firms from international competition, preventing labor force from shifting toward more productive sectors of the economy; (2) currency devaluation practices can serve as a subsidy to less productive firms; and (3) revealed comparative advantage in natural resources or extractive sector.

Ciccone and Papaioannou (2008) analyses the flow of labor between sectors subject to barriers to entry, documenting a significant role for this kind of friction among manufacturing industries. Cheremukhin et al. (2017) finds that barriers to entry and monopoly powers in the non-agricultural sector largely explain the failure to industrialize the Russian economy over the Tsarist and Soviet periods. There are no empirical studies that attempt to estimate the frictions at the sectoral level and to quantify the impact of structural reforms on sectoral labor reallocation. To this end, this paper proposes an empirical methodology to measure frictions and the role of labor market reforms in supporting structural transformation.

As suggested by the aforementioned studies, a specific set of structural reforms are expected to have an impact on structural transformation in this respect, of which labor reforms are usually ranked high. A reform that has the potential to create jobs in higher productivity sectors and allow more fluid mobility of labor could potentially do so through the following channels, *with respect to labor demand*: 1) easing regulations around the destruction of jobs in activities of low productivity; 2) lowering the costs of hiring in sectors of higher productivity; 3) removing regulatory and market biases that would channel more capital or financial resources to a sector than is justified by its relative value added; 4) allowing market access to competitive sectors; 5) boosting confidence and lowering uncertainty about growth prospects in productive sectors, *with respect to labor supply*; 6) protecting labor rights; 7) providing a social safety net that could encourage risk taking in job transition; and 8) providing easier access and more exposure to opportunities for training and skill development.

3 Data

The dataset is taken from several sources. The Groningen Growth and Development Center 10 sectors (GGDC) database provides data on annual series of value added, output deflators, and persons employed for 10 broad sectors for 44 countries in the US, Europe, Africa, Asia, and Latin America. The sample period is unbalanced and runs between 1950 and 2013; see tables (A.1 andA.2).

The labor market regulations indicators are part of recent indices compiled by the IMF of *de jure* reforms and liberalization in the real and financial sectors (IMF (2008)). While these annual indicators span enacted reforms in other areas like international trade, FDI, and the financial sector (banking system and capital market), in this study we only use the labor market indices (Schindler and Aleksynska (2011)). We examine four indicators: Average labor costs, average employee payroll taxes, ratio of minimum wage to mean wage, and unemployment coverage. The first two measure the regulatory financial burden associated with creating or holding a job, which increases proportionally with its productivity, while the last two indicators reflect the welfare aspects of labor market institutions; both areas are the subject of continuing debate on the optimal economic policies for inclusive growth. The time interval is between 1980 and 2005.

In addition, I also use the labor market measures from the Economic Freedom indicators, which are available on an annual basis from 2000 through 2013. These include measures of hiring and firing regulations, centralized collective bargaining, mandated cost of worker dismissal, and a labor market regulations summary index.

4 Structural transformation in aggregate labor productivity

We start the analysis by showing the magnitude of the role played by the process of structural transformation in the growth of aggregate labor productivity. To measure the contribution to labor productivity growth from the reallocation of labor across sectors of the economy, we use a variant of the canonical decomposition originating from Fabricant (1942):

$$\Delta P = \sum_i (P_i^T - P_i^0)S_i^0 + \sum_i (S_i^T - S_i^0)P_i^0 + \sum_i (P_i^T - P_i^0)(S_i^T - S_i^0) \tag{1}$$

where S_i is the share of sector i in overall employment, P_i the labor productivity level of sector i, and superscripts 0 and T refer to initial and final period. In the equation, the change in aggregate productivity is decomposed into within-sector productivity changes (the first term on the right-hand side that we call the "within-effect," also known as "intra-effect") and two other effects. The within-effect is positive when the weighted change in labor productivity levels in sectors is positive. The second term measures the contribution of labor reallocation across sectors, being positive when

Table 1: Aggregate productivity decomposition

Country	Within sectors	Cross sectors	Interaction	Country	Within sectors	Cross sectors	Interaction
ARG	106	9	-15	KEN	228	-409	281
BOL	76	442	-419	KOR	98	10	-7
BRA	102	24	-26	MAR	111	10	-20
BWA	194	-17	-78	MEX	55	122	-77
CHL	196	-27	-70	MUS	95	20	-16
CHN	82	5	14	MWI	-34	406	-272
COL	1209	-2189	1080	MYS	115	-10	-4
CRI	127	80	-107	NGA	433	-134	-199
DNK	141	-19	-22	NLD	72	33	-5
EGY	211	-46	-65	PER	132	-3	-29
ESP	51	55	-6	SEN	103	155	-158
ETH	23	150	-59	SGP	143	-22	-21
FRA	86	22	-8	SWE	122	-8	-13
GBR	137	-1	-36	THA	50	63	-13
GHA	85	19	-4	TWN	108	-6	-2
HKG	135	-5	-30	TZA	7	130	-37
IDN	85	10	5	USA	124	-3	-21
IND	76	32	-9	VEN	122	-109	87
ITA	99	11	-10	ZAF	151	58	-110
JPN	96	15	-11	ZMB	64	123	-86

Table reports the decomposition of aggregate labor productivity gains between 1990 and 2005 for all countries in our sample, following equation (1). Numbers are in percentages.

labor moves from less to more productive sectors (structural change), our term of interest. The third term in the equation is known as the cross term or interaction term. It represents the joint effect of changes in employment shares and sectoral productivity growth.

Table (1) reports the computed results for all countries in our sample, and table (2) summarizes its statistics. Over the full sample, we find that the median contribution of labor flows across sectors to aggregate labor productivity growth is 6.6%; however the distribution is skewed to the left, with the left 14th quantile as low as 295.2 %. The low magnitude of the median value and the very negative left tail reflect the difficulty economies face in utilizing the structural transformation potential for productivity growth as well as the high level of misallocation and failure of many economies to reallocate labor toward higher productivity sectors over time.

On the other hand, breaking the sample by income group reveals that gains in the labor productivity growth of high-income countries over the same time period appears to have been far higher than that of low income countries. The median for the latter is negative amounting to -53.9 %, pointing at lost opportunities in countries at the lower end of the income distribution. High-income countries have a distribution of results with a relatively more symmetric tails and a median of 9.88% .

Table (3) reports the potential gains that countries could attain by merely mobilizing labor across sectors such that labor productivities across sectors were equated, and table (4) reports its summary. The large magnitude of the figures especially for low income countries, which ranges between 92.8

Table 2: Summary statistics of table (1)

	Median	84th Quantile	14th Quantile
Full Sample	6.60	67.50	-295.20
High-income countries	9.88	22.09	-6.19
Low-income countries	-53.88	76.02	-573.99

The results are in percentage with respect to aggregate labor productivity growth between 1990 and 2005. Low-income countries include countries classified by the world bank as low or lower middle income. High-income countries include those classified as high or higher middle income countries.

Table 3: Potential gains in aggregate labor productivity labor.

Country	Potential Gains	Country	Potential Gains	Country	Potential Gains	Country	Potential Gains
ARG	58.67	EGY	1737.81	KOR	56.35	SEN	314.65
BOL	371.06	ETH	170.62	MAR	66.4	SGP	76.65
BRA	88.64	GHA	93.03	MEX	169.92	THA	251.23
BWA	301.45	HKG	135.89	MUS	32.69	TWN	58.07
CHL	147.45	IDN	166.67	MWI	176.38	TZA	166.1
CHN	70.15	IND	91.69	MYS	294.15	USA	29.11
COL	151.91	JPN	19.16	NGA	3682.85	VEN	219.2
CRI	41.88	KEN	102.51	PER	114.05	ZAF	49.41

The table reports the potential gains in aggregate labor productivity from reallocating labor across sectors such that there is no labor productivity gaps across them. Computation is based on the observed productivity and labor shares per sector in 2010. Computed numbers are in percentage as a ratio aggregate productivity in 2010.

and 617.08 % give a profound motivation for policy reforms that aim at removing institutional and regulatory impediments to labor flows from low to high productivity sectors.

Table 4: Summary statistics of table (3)

	Median	84th Quantile	14th Quantile
Full Sample	124.97	305.31	53.71
High-income countries	58.07	137.74	27.52
Low-income countries	168.65	617.08	92.79

The figures are the summary statistics of the expected gains in aggregate labor productivity from labor reallocation across sectors in percentage terms with respect to aggregate labor productivity in 2010. Low-income countries include countries classified by the world bank as low or lower middle income. High-income countries include those classified as high or higher middle income countries.

5 An ECM framework of the dynamics of sector level employment shares

5.1 Theoretical motivation

There are two main theoretical approaches attempting to explain the process of structural transformation across economic sectors in a growing economy. The first approach relies on the demand-side effects generated by growing income when preferences are non-homothetic (e.g. Laitner (2000), Gollin, Parente, and Rogerson (2002)). As income levels grow, consumption saturates for one sector after another, and the increase in wealth flows into different sectors, i.e. after a certain level of income, consumption of manufactured goods rises with higher income levels while spending on agricultural products saturates; the same mechanism also works between manufacturing and services. According to this mechanism, a structural transformation is a necessary feature that accompanies income growth and an ever-continuing process, whereby the relative value added and prices of saturating sectors decline perpetually.

The second approach is the supply-side approach, discussed by Ngai and Pissarides (2007), where employment shares are driven by the relative magnitude of productivity growth across sectors. Relative prices play a key role here; higher productivity growth sectors experience lower relative prices since demand is unable to catch up with the increasing supply of output. The lower prices put downward pressure on labor compensation and prompts an outflow of labor from sectors with higher productivity growth rates, such as agriculture, thus helping to restore the balance in labor productivity across sectors. According to this channel, employment shares across sectors are set such that labor productivity (i.e. wages) are equal across sectors, and structural transformation is triggered when the growth rate of a sector's TFP exogenously changes.

No matter which of the two mechanisms drives the transformation dynamics, labor moves across sectors with the goal to restore the balance in labor productivity; otherwise, agents have no incentive to reallocate. In a frictionless economy, this flow of labor ensures equal labor productivity across any two sectors i and j at any point in time t in country c,

$$LaborProductivity_{i,t} = LaborProductivity_{j,t} \tag{2}$$

$$\frac{VA_{i,c,t} \times P_{i,c,t}}{N_{i,c,t}} = \frac{VA_{j,c,t} \times P_{j,c,t}}{N_{j,c,t}} \tag{3}$$

where VA_i is the value added per sector i, P_i is the relative price of sector i output, and N_i is the size of labor force it employs. This relation implies that sectoral employment shares maintain the following *optimal* expression,

$$\frac{N^*_{i,c,t}}{N^*_{j,c,t}} \equiv \frac{VA_{i,c,t} \times P_{i,c,t}}{VA_{j,c,t} \times P_{j,c,t}} \tag{4}$$

under either homothetic or non-homothetic preferences, and irrespective of how different TFP growth rates are across sectors, theory predicts no gaps in labor productivity across sectors.

However, multi-sector growth models, like Gollin, Parente, and Rogerson (2002)) and Ngai and Pissarides (2007), assume a frictionless world, where labor allocations and prices can fully adjust to restore optimality in response to changes in aggregate income or relative sector level productivities, respectively. Nonetheless, the presence of structural market and institutional frictions slow down this adjustment process, allowing labor to only partially reallocate; as a result, a wedge grows between the observed sector level allocation of labor and the optimal plan where labor productivities across sectors are equalized. It is important to note that the rate of this partial adjustment and the size of this wedge are both functions of the structural frictions impeding the efficient flow of labor force. We use this intuition to quantify the magnitude of the frictions facing labor reallocation in the economy by estimating the rate of adjustment within a Co-integrated Error Correction Model (ECM).

Proposition 1. *The ECM model can be interpreted as the optimal adjustment rule in an economy where labor in lower productivity sectors forgoes potential earnings by not reallocating toward higher productivity sectors and, at the same time, it also has costs if it carries out rapid adjustments, i.e. reallocation. Under a simple quadratic specification of this adjustment costs,*

$$C(\frac{N_{i,c,t}}{N_{j,c,t}}, \frac{N^*_{i,t}}{N^*_{j,t}}) = \frac{1}{2}(\frac{N_{i,c,t}}{N_{j,c,t}} - \frac{N^*_{i,c,t}}{N^*_{j,c,t}})^2 + \frac{\kappa}{2}\Delta\left(\frac{N_{i,c,t}}{N_{j,c,t}}\right)^2 \tag{5}$$

where $N_{i,t}$ is the employment level in sector i at time t, which tracks, but may deviate from, the optimal level $N^*_{i,t}$, as described in equation (4), and κ is the ratio of the marginal cost of adjustment relative to the marginal cost of being away from the optimal allocation $N^*_{i,t}$, ***then*** *labor in lower productivity sectors reallocate, to minimize C in equation (5), such that at any point in time t the following Error Correction model exactly describes employment shares allocations for an efficient economy,*

$$\Delta\left(\frac{N_{i,c,t}}{N_{j,c,t}}\right) = \lambda\left(\frac{N^*_{i,c,t}}{N^*_{j,c,t}} - \frac{N_{i,c,t-1}}{N_{j,c,t-1}}\right) = \lambda\Delta\left(\frac{N^*_{i,c,t}}{N^*_{j,c,t}}\right) - \lambda\left(\frac{N_{i,c,t-1}}{N_{j,c,t-1}} - \frac{N^*_{i,c,t-1}}{N^*_{j,c,t-1}}\right) \tag{6}$$

where $\lambda \equiv \dfrac{1}{1+\kappa}$ is the speed of labor reallocation and $0 < |\lambda| < 1$; if it is negative (positive), the closer it is to 1, the faster the rate at which job flows are able to narrow (widen) productivity gaps.

Proof. See Pagan (1985) and Alogoskoufis and Smith (1991) for derivations of a generic ECM application. □

The observation that the ECM model shows up as an analytical solution for the optimal structural transformation process in a model where labor reallocation is costly is only one part of our motivation behind the use of this framework. Another large part stems from that fact that the ECM environment captures the main empirical patterns of structural transformation and, therefore, allows for a direct estimation of its key structural parameters: First, the underlying process of structural transformation is non-stationary, meaning that sectoral labor shares and productivities maintain a secular trend over time, as observed in the data and documented in Herrendorf, Rogerson, and Valentinyi (2013) for instance. Second, since these trends are driven by the same underlying process of TFP or income growth, they are co-integrated. Third, in the short run, sector output and employment are subject to disturbances that move them away from their co-integration equilibrium values. Fourth, there are frictions in the adjustment process of labor, output, and prices that prevent an instantaneous reversion to the trend. By preserving the co-integration relation between the variables, the ECM model allows for estimating both long and short-term elasticities as well as the speed of the adjustment. While the model has a long history in time series analysis, its application to panel dynamics is limited (Yasar, Nelson, and Rejesus (2006)).

5.2 The role of human capital

One leading explanation that could be put forward to explain part of the persistence in productivity gaps refers to the heterogeneity in human capital across sectors and countries (Alvarez et al. (2018), Herrendorf and Schoellman (2017)). According to this channel, the labor force does not reallocate from lower to higher productivity sectors because it faces market or institutional impending factors, but because it lacks the knowledge and necessary skills to perform different tasks. Under this view, the flow of jobs from lower to higher productivity sectors stops when the skill barrier is reached, which occurs before labor productivities are equated,

$$LaborProductivity_{i,t} > LaborProductivity_{j,t} \tag{7}$$

let $\gamma_{i,j,c,t}$ be the magnitude of the productivity differential between workers in two different sectors i, j at country c at time t, then,

$$(1 - \gamma_{i,j,c,t})\Big(\frac{VA_{i,c,t} \times P_{i,c,t}}{N^*_{i,c,t}}\Big) = \frac{VA_{j,c,t} \times P_{j,c,t}}{N^*_{j,c,t}} \tag{8}$$

This specification implies that the human capital induced wedge in labor productivities across sectors is a share of the labor productivity of the higher productivity sector; that is, the higher

the productivity of sector i, the larger the absolute value of its gap with respect to sector j. For instance, assuming no market or institutional frictions in a country like Egypt, labor should ideally be able to flow from the agriculture sector to manufacturing, up to the point where the skill barrier binds; at this point, the gap between average labor productivity of a worker in manufacturing and agriculture is $\gamma_{m,a,Egy,t}$ times the average labor productivity of a worker in manufacturing, which increases as manufacturing productivity increases.

Hence, in a frictionless economy, the flow of jobs across sectors takes place such that the sector level employment shares are described according to the following expression,

$$\frac{N^*_{i,c,t}}{N^*_{j,c,t}} \equiv (1 - \gamma_{i,j,c,t}) \frac{VA_{i,c,t} \times P_{i,c,t}}{VA_{j,c,t} \times P_{j,c,t}} \tag{9}$$

that is, the feasible optimal employment share of sectors with lower productivity and lower skill levels becomes larger in comparison to equation (4) due to the introduction of the human capital term $\gamma_{i,j,c,t}$.

This human capital channel raises a challenge for empirical work given the lack of a good measure for human capital, in general, and at the sector level in particular (cite?????). We overcome this problem by making the assumption that $\gamma_{i,j,c,t}$ is constant across countries such that $\gamma_{i,j,c,t} \equiv \gamma_{i,j,t}$; in other words, we assume that the productivity differentials are sector specific irrespective of the country. For instance, the difference in the skills required for a job in services compared to manufacturing at year t does not depend on whether these jobs are in France or Morocco. Continuing with this example, this implies that the difference in human capital between any services and manufacturing is the same in France and Morocco, even though there is a difference between the two countries in terms of the levels of human capital in manufacturing or services.

5.3 Econometric specification

The goal of the econometric analysis is to estimate the magnitude of the frictions facing sector level flows in labor markets across countries. Using the ECM model, we estimate the speed of adjustment parameter λ for the whole sample, and for different sectors and country groups. This parameter is the rate at which jobs flow from one sector to another, which is an implied measure of the magnitude of adjustment costs (i.e. frictions). A negative estimate of λ would imply converging productivity gaps across sectors, while a positive one would imply a diverging pattern whereby gaps grow even wider.

In the baselines specification, we estimate λ for the full sample first and then attempt to explore the heterogeneity across country groups and sectors by estimating it for the corresponding subsamples. Substituting equation (4) into (6), after log transforming the variables yields an ECM of labor

reallocation dynamics:

$$\Delta log\left(\frac{N_{i,c,t}}{N_{j,c,t}}\right) = \overbrace{\beta_1 \Delta log\left(\frac{VA_{i,c,t}}{VA_{j,c,t}}\right) + \beta_2 \Delta log\left(\frac{P_{i,c,t}}{P_{j,c,t}}\right) + \beta_3 \Delta X_{i,c,t}}^{\text{Short Term Dynamics}} + \underbrace{\lambda\left(log\left(\frac{N_{i,c,t-1}}{N_{j,c,t-1}}\right) - \left[\delta_1 log\left(\frac{VA_{i,c,t-1}}{VA_{j,c,t-1}}\right) + \delta_2 log\left(\frac{P_{i,c,t-1}}{P_{j,c,t-1}}\right) + \delta_3 X_{i,c,t-1}\right]\right)}_{\text{Long Term Dynamics}} + u_{i,c,t} \quad (10)$$

where X_t includes controls for factors that may justify persistent deviation (i.e. error) in observed employment shares from the efficient allocation described by equation (4), such as differences in human capital and the skill level of workers. We control for the human capital effects by including a (sector $\times$time) fixed effect, given the assumption discussed above of a constant γ across countries. The fixed effects also control for essential differences across sectors and countries (e.g. capital intensity).

Specifically, X_t includes world real GDP growth rate, growth rate of countries real GNP per capita, population growth rate, a global linear trend, as well as constant and linear trend fixed effects: (sector $\times$ country) and (linear trend $\times$ sector $\times$ country); these additional controls make sure that the estimated rate of adjustment captures only country level market and institutional factors, and is not contaminated with the effects of demographic and other global and sector specific trends or global fluctuations. β_1, β_2 and β_3 are the short term elasticities, λ corresponds to the adjustment speed, and δ_1, δ_2 and δ_3 correspond to the long term elasticities. Equation (10) implies that labor moves every period to correct past deviations from the optimal values of employment shares (i.e. long term target), and to accommodate contemporaneous changes in these optimal allocations (short term dynamics). In all our estimations, we always use the agriculture sector as sector j; such that employment and value added shares as well as sector price levels are normalized by the corresponding values for the agriculture sector.

The role of labor market frictions in labor reallocation

Next, we explore the answer to the second main question of the paper on the magnitude of the part played by labor market regulations in the process of structural transformation. We carry out this task by augmenting the baseline equation (10) to introduce a country level labor market indicator R_t via an interaction term with the rate of adjustment.

$$\Delta log\left(\frac{N_{i,c,t}}{N_{j,c,t}}\right) = \beta_1 \Delta log\left(\frac{VA_{i,c,t}}{VA_{j,c,t}}\right) + \beta_2 \Delta log\left(\frac{P_{i,c,t}}{P_{j,c,t}}\right) + \beta_3 \Delta X_{i,c,t} + \lambda_1 Gap_{i,j,c,t-1} + \overbrace{\lambda_2\{R_{t-1} \times Gap_{i,j,c,t-1}\}}^{\text{Labor market Interaction}} + Z_{t-1} + u_{i,c,t} \quad (11)$$

where,

$$Gap_{i,j,c,t} \equiv \left(log\left(\frac{N_{i,c,t-1}}{N_{j,c,t-1}}\right) - \left[\delta_1 log\left(\frac{VA_{i,c,t-1}}{VA_{j,c,t-1}}\right) + \delta_2 log\left(\frac{P_{i,c,t-1}}{P_{j,c,t-1}}\right) + \delta_3 X_{i,c,t-1}\right]\right) \tag{12}$$

and D^{Low}_{Income} is a dummy for countries that belong to lower middle income and low income classification of the World Bank. Z_t is a vector that include controls for other areas of regulations that could be correlated with the state of labor market institutions. For that, we use the IMF structural reform indices for four key areas: capital flows, banking, domestic finance, and trade. In addition, we also include the other components of the labor market regulations when examining their interaction individually,

$$Z_t \equiv \{R_t^{CapitalFlows}, R_t^{Banking}, R_t^{DomesticFinance}, R_t^{Trade}, R_t^{Avg.LaborCost}, R_t^{Avg.payrolltax}, R_t^{MinimumWageMeanWageRatio}\} \tag{13}$$

λ_2 is a measure of the contribution of R_{t-1} in explaining the differences across high-income countries in the average pace of job flows across sectors. We also add another interaction term for low- and high-income country groups, to analyze whether the role labor market regulations plays changes for economies that are at different stages of development,

$$\Delta log\left(\frac{N_{i,c,t}}{N_{j,c,t}}\right) = \beta_1 \Delta log\left(\frac{VA_{i,c,t}}{VA_{j,c,t}}\right) + \beta_2 \Delta log\left(\frac{P_{i,c,t}}{P_{j,c,t}}\right) + \beta_3 \Delta X_{i,c,t} + \lambda_1 Gap_{i,j,c,t-1} + \overbrace{\lambda_2\{R_{t-1} \times Gap_{i,j,c,t-1}\} + \lambda_3\{D^{Low}_{Income} \times R_{t-1} \times Gap_{i,j,c,t-1}\}}^{\text{Labor market Interaction}} + Z_{t-1} + u_{i,c,t} \tag{14}$$

λ_3 measures how much λ_2 changes for low-income countries compared to high-income countries.

5.4 Estimation

We estimate equations (10) and (11) in two stages. In the first stage, we extract the *stationary* error term (the 'Gap' term) using the co-integration relation (i.e. Long run dynamics) in equation (10) using Pooled OLS. In the second stage, we substitute this error term and estimate the short term elasticities as well as the adjustment speed parameter λ using fixed effect OLS. The endogeneity between employment shares, on the one hand, and sectoral value added and price levels, on the other hand, do not concern us because obtaining a consistent estimator of short term elasticities is not the objective of the analysis; these two endogenous terms work as conditioning information (i.e. controls) that allows the identification of the adjustment rate parameter. In addition, the

endogeneity induced by the inclusion of the fixed effect in our dynamic setting (Nickell (1981)) is also not a concern within the context of our long panel where the time dimension is fairly large.

6 Results and discussion

6.1 Baseline estimation

The results of the baseline regression for the labor reallocation process, equation (10), are reported in Table (5). Our main interest is the estimated value of the adjustment rate λ, which is the coefficient on the deviation or gap term. Its estimated value is -0.154. The negative sign confirms a convergence pattern; that is, it verifies that, on average, employment shares move toward closing the labor productivity gap across sectors. The magnitude of the speed implies that the average economy in our sample reallocates its labor across different sectors to close 15.4% of the distance between its current and desired long run allocation within one year. It is important to note that by controlling for human capital, country income growth rate and other fixed effects, we make the assumption that the economy's desired plan of labor allocation across sectors does not necessarily eliminate productivity gaps completely. While this assumption deviates from our theoretical motivation to some extent, it reflects the structural and technological barriers in the economy that may not be easily surpassed overtime; for instance, sectors that rely on natural resources like mining cannot fully expand enough to absorb all willing labor force.

Table 5: Labor Reallocation Baseline Results

Dependent Variable: $\Delta log\left(\frac{N_{i,c,t}}{N_{j,c,t}}\right)$

Explanatory Variables		Est.	Std. Error	t-statistic	Pr(>|t|)
Relative Value Added	$\Delta log\{VA_{i,c,t}/VA_{j,c,t}\}$	0.323	0.011	0.297	0.000
Relative Sectoral Prices	$\Delta log\{P_{i,c,t}/P_{j,c,t}\}$	0.048	0.010	5.029	0.000
GNP Per Capita	$\Delta X_{i,c,t}$	0.033	0.006	5.883	0.000
Gap	LT Dynamics	**-0.154**	0.008	-18.731	0.000
R^2: 0.211					
adj R^2: 0.155					
Unbalanced Panel: n = 277, T = 4-50, N = 10748.					
Time and Individual fixed effects OLS estimation.					

The table reports the estimation results for equation (10). Estimation uses both individual (*sector* × *country*) and time fixed effects, and robust inference, where clustering is on the *sector* × *country* level.

6.2 Baseline estimation across sub-groups

We repeat the estimation over sub-samples split according to income groups, regions, and economic sectors, reporting the results for the adjustment rate in tables (6, 7 and 8), respectively. We find that the persistence of productivity gaps correlates with country income; that is, high-income countries enjoy the most dynamic labor force, allowing them to close productivity gaps across sectors with

a faster speed (25.2 % a year). This speed drops to 19.7 % for upper middle income countries, 12.5 for lower middle income countries, and 9.4 % for low income countries. Interestingly, these numbers reflect a nonlinear relationship between country income and the flexibility with which it is able to reallocate its labor force across sectors. We see that labor force mobility across sectors in high-income countries is 5.5 % faster than that of upper middle income countries, but the latter is 7.2 % faster than lower middle income countries. This difference shrinks again between lower middle income and low-income countries to 3.1 %, pointing at a significant institutional gap between low and high income groups.

Different channels could potentially explain this association between higher income levels and higher sectoral labor mobility. The first channel, addressed by our analysis, is the labor market regulation channel; higher income countries enjoy better institutional frameworks that allows more fluid creation and destruction of jobs in reaction to changes in sector level TFP or the aggregate income level. Another potential channel is linked to the magnitude of geographical frictions, which limit mobility across regions and cities. Since different regions may adopt different specialization patterns, the efficiency of the structural transformation process depends on the capacity of workers to physically move. Hnatkovska and Lahiri (2018) discusses the contribution of this channel in explaining differences in the Chinese and Indian transformation experience.

Differences in human capital across income groups could also explain the disparity we observe in the fluidity of their structural transformation processes. For workers to efficiently change sectors, they need to maintain adequate levels of transferable skills and education. In both respects, we expect high-income countries to be in a better position given the accessibility and universality of their education systems.

The results of reallocation speed across regions reveals another dimension of heterogeneity. We find the fastest labor share dynamics in Asia, followed by Latin America, Europe-USA, and, finally, Africa. This is consistent with the evidence on the significant structural transformation that took place in these faster regions in the second half of the twentieth century, compared to the western countries that experienced their main wave in the 19th and 18th centuries, and African countries that are yet to undergo major transformations. What this tells us is that structural transformation is most dynamic in countries with not just better institutions, as proxied by income, but also higher transformation potential.

Looking at the reallocation speed across sectors, we see that mining and manufacturing are the fastest in attracting labor out of agriculture, followed by construction, utilities, government services, and, finally, services sectors, such as trade, restaurants and hotels, and transport, storage, and communication. The results reflect government efforts around the world to move labor toward mining and manufacturing, especially mining which still maintains the widest productivity gap in developing countries with respect to other sectors. The estimates also point at the higher rigidity that faces the economy in reallocating its employment shares toward services industries such as trade and communication.

Table 6: Rate of adjustment across income groups

Income Group	N. Obs.	λ Estimate	Std. Error	t-statistic	Pr(>|t|)
High income	3233	-0.252	0.025	-10.087	0.000
Upper middle income	3684	-0.197	0.015	-13.542	0.000
Lower middle income	2913	-0.125	0.014	-8.650	0.000
Low income	918	-0.094	0.026	-3.587	0.000

The table reports the estimation results for the adjustment rate λ in equation (10) by income group. Estimation uses both individual (*sector* $\times$ *country*) and time fixed effects, and robust inference, where clustering is on the *sector* $\times$ *country* level.

Table 7: Rate of adjustment across regions

Region	N. Obs.	λ Estimate	Std. Error	t-statistic	Pr(>|t|)
Asia	2800	-0.261	0.022	-11.903	0.000
Latin America	2412	-0.220	0.019	-11.524	0.000
Europe-USA	1911	-0.178	0.022	-8.136	0.000
Africa	3625	-0.102	0.011	-9.098	0.000

The table reports the estimation results for the adjustment rate λ in equation (10) by region. Estimation uses both individual (*sector* $\times$ *country*) and time fixed effects, and robust inference, where clustering is on the *sector* $\times$ *country* level.

Table 8: Rate of adjustment across sectors

Sector	N. Obs.	λ Estimate	Std. Error	t-statistic	Pr(>|t|)
Mining	1569	-0.186	0.019	-9.909	0.000
Manufacturing	1579	-0.155	0.018	-8.614	0.000
Construction	1579	-0.147	0.018	-8.151	0.000
Utilities	1569	-0.143	0.017	-8.545	0.000
Government services	1196	-0.140	0.017	-8.427	0.000
Trade, restaurants and hotels	1579	-0.119	0.017	-7.152	0.000
Transport, storage and communication	1579	-0.115	0.016	-7.011	0.000

The table reports the estimation results for the adjustment rate λ in equation (10) by sector. Estimation uses both individual (*sector* $\times$ *country*) and time fixed effects, and robust inference, where clustering is on the *sector* $\times$ *country* level.

6.3 The Role of labor regulations

In this part of the analysis, we assess the extent to which structural reforms and regulations in the labor market are associated with less persistent productivity gaps across sectors. Table (9) reports the estimation results for equation (11) for the full sample, where λ_2 reflects the contribution of the respective indicator to the pace by which labor reallocates across sectors. A negative estimate implies an accelerating effect, and vice versa. In table (10), we repeat the same estimations while accounting for the heterogeneity between high and low income countries. Overall, the data reflects a relatively large role for the area of labor market regulations as indicated by their corresponding λ_2, λ_3. Policy reforms aiming at achieving efficient structural transformation need to maneuver between the goal of raising labor productivity, while maintaining strong social nets, labor protection and risk sharing.

Table 9: The role of labor regulations

Indicator	Source	No. Obs.	λ_2	Std. Errors	Pr(>|t|)
Hiring and firing regulations	EF	974	-0.0035	0.0030	0.2396
Centralized collective bargaining	EF	1050	-0.0020	0.0031	0.5300
Mandated cost of worker dismissal	EF	432	0.0112	0.0033	0.0007
Labor market regulations	EF	1024	-0.0078	0.0045	0.0875
Average labor cost	IMF SR	3720	0.0014	0.0012	0.2436
Average employee payroll taxes	IMF SR	3720	0.0023	0.0027	0.3878
Ratio of minimum wage to mean wage	IMF SR	3720	0.0004	0.0011	0.6924
Unemployment benefits coverage	IMF SR	3176	0.0019	0.0025	0.4382
Time and Individual($sector \times country$) fixed effects OLS estimation.					

We scaled all indicators to a scale of 100

For the full sample, we find that only two indicators are significant. The mandated cost of worker dismissal and the general labor market regulations indices. Both indicators come from the Economic Freedom indices and are constructed such that higher values indicate more open and less regulated market. The negative result of λ_2 for the general labor market regulation index is consistent with Haltiwanger, Scarpetta, and Schweiger (2014) and implies that an increase in the freedom of labor market regulations by 10 on a scale of 100 is associated with 7 % increase in the pace of job flows across sectors. Hence, fewer regulations correspond to more dynamic labor force and more efficient employment shares allocations.

Interestingly, the result for mandated cost of worker dismissal indicator is not necessarily what one would expect to see in the typical discussions on labor market reforms. We find that lowering the cost of worker dismissal dampens the pace of job flows. This result suggests that reforms that undermine job security, while allowing firms to be more dynamic and agile in reacting to market fluctuations, could have a strong discouraging effect on labor transitions. This is particularly relevant for the structural transformation process where the job transition across sectors, which may also require migration, entails higher risk and social costs than transition within sectors. Hence, the policy agenda on labor market reforms needs to be advised on the effect of these reforms on labor incentives to shift careers and reallocate.

Controlling for the country income level when estimating the effect of labor market measures on the pace of structural transformation across reveals some heterogeneity aspects and allows a stronger identification of the effects of some of the measures (table (10); in addition to the earlier results with respect to mandated dismissal costs and the aggregate labor market regulation indices, the effects of both hiring and firing regulations as well as bargaining appear negative and significant. This is consistent with the general wisdom on the topic, which suggests that lower regulations and more flexible wage setting can ease the labor market dynamics. For these measures, there does not seem to be a significant difference between high and low income countries.

More interesting, however, are the results for λ_2 and λ_3 for average labor costs, employee payroll

taxes, and minimum wages. While they remain insignificant for the high-income group (i.e. λ_2), they are positive and significant for low-income countries. An increase by 10 on a scale of 100 of labor costs is associated with 1.8 % decline in the pace of job flows for low income countries, but has an insignificant effect for high income countries. This number is 1.2 % and 4 % for 10 points increase in average payroll taxes and minimum wages ratio to mean wages, respectively, in low income countries. What this implies is that policy agendas need to be different for high- and low-income countries; for the latter, there seems to be a larger gain potential from targeting the costly and overly generous labor regulations.

Table 10: The role of labor regulations

Indicator	Source	No. Obs.	λ_2	Std. Errors	Pr(>|t|)	λ_3	Std. Errors	Pr(>|t|)
Hiring and firing regulations	EF	606	-0.0089	0.0035	0.0119	-0.0042	0.0026	0.1149
Centralized collective bargaining	EF	681	-0.0053	0.0035	0.1318	0.0003	0.0014	0.8344
Mandated cost of worker dismissal	EF	250	0.0113	0.0035	0.0016	0.0032	0.0048	0.5013
Labor market regulations	EF	662	-0.0096	0.0065	0.1363	0.0004	0.0024	0.8760
Average labor cost	IMF SR	2593	-0.0003	0.0014	0.8575	0.0021	0.0006	0.0005
Average employee payroll taxes	IMF SR	2593	-0.0006	0.0026	0.8105	0.0018	0.0005	0.0005
Ratio of minimum wage to mean wage	IMF SR	2593	0.0008	0.0012	0.4990	0.0032	0.0006	0.0000
Time and Individual($sector \times country$) fixed effects OLS estimation.								

We scaled all indicators to a scale of 100

7 Conclusion

This paper documents the role of labor markets regulations in the misallocation of labor across sectors within the economy. The rigidities caused by these regulations inhibit the efficient flow of jobs across sectors and result in inefficient allocations of employment shares and lost opportunities for productivity growth. Excessive labor regulations make hiring and firing costly for firms, discouraging, in return, both job destruction in lower productivity occupations and job creation in higher productivity ones. While these frictions are also binding for many developed economies, understanding the obstacles to efficient structural transformation is particularly valuable for developing economies, which have set in place ambitious sectoral policies to boost potential growth, but where productivity and employment outcomes continue to lag behind expectations.

Our analysis argues that addressing these labor market frictions could help promote more fluid reallocation toward higher productivity sectors, raising growth and employment. However, these policy reforms need to maneuver between the goal of easing job creation and destruction, while supporting the labor supply incentives to reallocate and shift industries through strong social nets, labor protection, and risk sharing. In addition, there is no one-size-fits-all policy prescription for all countries, given individual circumstances and growth experiences. Reform priorities depend on country-specific settings, including the scale of particular policy distortions.

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Appendices

A Data Appendix

Table A.1: Sectoral Coverage

Sector name	ISIC Rev. 3.1 description
Agriculture	Agriculture, Hunting and Forestry, Fishing
Mining	Mining and Quarrying
Manufacturing	Manufacturing
Utilities	Electricity, Gas and Water supply
Construction	Construction
Trade services	Wholesale and Retail trade; repair of motor vehicles, motorcycles and personal and household goods, Hotels and Restaurants
Transport services	Transport, Storage and Communications
Business services	Financial Intermediation, Renting and Business Activities (excluding owner occupied rents)
Government services	Public Administration and Defense, Education, Health and Social work
Personal services	Other Community, Social and Personal service activities, Activities of Private Households
Total Economy	Total Economy

Table A.2: Baseline Regression Country and Time Coverage

Acronym	Country	Nominal Value Added	Sectoral Prices	Sectoral Employment
Sub-Saharan Africa				
BWA	Botswana	1964-2010	1964-2010	1964-2010
ETH	Ethiopia	1961-2010	1961-2010	1961-2010
GHA	Ghana	1960-2010	1960-2010	1960-2010
KEN	Kenya	1960-2010	1964-2010	1969-2010
MWI	Malawi	1960-2010	1966-2010	1966-2010
MUS	Mauritius	1960-2010	1970-2010	1970-2010
NGA	Nigeria	1960-2010	1960-2010	1960-2011
SEN	Senegal	1960-2010	1970-2010	1970-2010
ZAF	South Africa	1960-2010	1960-2010	1960-2010
TZA	Tanzania	1960-2010	1960-2010	1960-2010
ZMB	Zambia	1960-2010	1965-2010	1965-2010
North Africa				
EGY	Egypt	1960-2013	1960-2012	1960-2012
MOR	Morocco	1970-2012	1960-2012	1960-2012
Asia				
CHN	China	1952-2011	1952-2010	1952-2011
HKG	Hong Kong	1970-2011	1974-2011	1974-2011
IND	India	1950-2012	1950-2012	1960-2010
IDN	Indonesia	1966-2012	1960-2012	1961-2012
JPN	Japan	1953-2011	1953-2011	1953-2012
KOR	South Korea	1953-2011	1953-2011	1963-2011
MYS	Malaysia	1970-2011	1970-2011	1975-2011
PHL	Philippines	1971-2012	1971-2012	1971-2012
SGP	Singapore	1970-2012	1960-2012	1970-2011
TWN	Taiwan	1951-2012	1961-2012	1963-2012
THA	Thailand	1951-2011	1951-2011	1960-2011
Latin America				
ARG	Argentina	1950-2011	1950-2011	1950-2011
BOL	Bolivia	1958-2011	1950-2011	1950-2010
BRA	Brazil	1990-2011	1950-2011	1950-2011
CHL	Chile	1950-2011	1950-2011	1950-2012
COL	Colombia	1950-2011	1950-2011	1950-2010
CRI	Costa Rica	1950-2011	1950-2011	1950-2011
MEX	Mexico	1950-2011	1950-2011	1950-2012
PER	Peru	1950-2011	1950-2011	1960-2011
VEN	Venezuela	1960-2012	1950-2012	1950-2011
North America				
USA	United States	1947-2010	1947-2010	1950-2010
Europe				
DEW	West Germany	1968-1991	1950-1991	1950-1991
DNK	Denmark	1970-2011	1947-2009	1948-2011
ESP	Spain	1970-2011	1947-2009	1950-2011
FRA	France	1970-2011	1950-2009	1950-2011
GBR	United Kingdom	1960-2011	1949-2009	1948-2011
ITA	Italy	1970-2011	1951-2009	1951-2011
NLD	The Netherlands	1970-2011	1949-2009	1950-2011
SWE	Sweden	1970-2011	1950-2009	1950-2011