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RESEARCH ARTICLE

Does One Law Fit All? Cross-Country Evidence on Okun's Law

Laurence Ball[1] · Davide Furceri[2,3] · Daniel Leigh[3] · Prakash Loungani[3,4]

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Abstract
This paper compares the performance of Okun's Law in advanced and developing economies. On average, the Okun coefficient—which measures the short-run responsiveness of labor markets to output fluctuations—is about half as large in developing as in advanced countries. However, there is considerably heterogeneity across countries, with Okun's Law fitting quite well for a number of developing countries. We have limited success in explaining the reasons for this heterogeneity. The mean unemployment rate and the share of services in GDP are associated with the Okun coefficient, whereas other factors such as indices of overall labor and product market flexibility do not appear to play a consistent role.

Keywords Unemployment · Okun's Law · Developing economies · Job creation

1 Introduction

The short-run relationship between output and labor market outcomes, documented by Okun (1962) for the United States, has since become famous as "Okun's Law". Ball, Leigh and Loungani, henceforth referred to as BLL (2017), show that Okun's Law has held up well for a set of 20 advanced economies. The responsiveness of unemployment or employment to output—the so-called Okun coefficient—does vary across countries, however, and for reasons that are not easy to explain.

✉ Prakash Loungani
PLOUNGANI@imf.org

[1] Johns Hopkins University, Baltimore, MD, USA

[2] University of Palermo, Palermo, Italy

[3] IMF, Washington, DC, USA

[4] Policy Center for the New South, Rabat, Morocco

This paper extends that work to a larger group of countries that includes several developing economies. The motivation is two-fold. First, these countries account for a large, and growing, share of the global labor force. Hence, understanding the determinants of labor market outcomes in these countries is important. There is ample evidence that job creation contributes to individual and social welfare, whereas unemployment and job loss are associated with persistent loss of income, health problems, and breakdown of family and social cohesion (see the World Bank's *World Development Report* on "Jobs" (2013) and Dao and Loungani (2010)).

A second motivation is to probe the common perception that labor market outcomes in developing countries reflect mostly structural factors rather than short-run cyclical fluctuations. Whether this perception is correct has important policy implications. If cyclical fluctuations account for a substantial part of labor market developments, macroeconomic stabilization policies—such as central bank actions, countercyclical fiscal policies and prudential policies to mitigate financial crises—gain in importance relative to structural policies (e.g. improving education and skills of the labor force).

The bulk of the literature on Okun's Law has been for advanced economies; the studies for developing economies have been for particular countries or sometimes for regions. To our knowledge, this paper provides the first comprehensive look at Okun's Law for a large set of countries over a fairly long period of time. We use 71 countries in our analysis, classified into 29 advanced and 42 developing countries. We use the IMF's *World Economic Outlook* classification to decide which countries are considered 'advanced'; the others are labeled developing. We restrict our sample to countries with at least 20 years of annual data and with a population exceeding 3 million. The time period is 1980 to 2015 but data for many developing countries starts later, as indicated in Table 10 in the Appendix.

Our three principal conclusions—based on estimating the short-run (annual) relationship between unemployment (or employment) and output—are as follows:

1) On average, labor markets are less responsive to output fluctuations in developing countries than in advanced. For instance, the responsiveness of unemployment to output is −0.2 in developing countries compared with −0.4 for advanced economies. The fit of Okun's Law is also poorer in developing countries than in advanced: the average R-square value is in the 0.2–0.3 range, again about half that in advanced countries.
2) However, as found by BLL (2017) for advanced economies, there is considerable heterogeneity across developing countries in the Okun coefficient and the fit of Okun's Law for developing countries. Hence there are a number of developing countries where short-run cyclical fluctuations appear to play an important role in labor market developments.
3) We have limited success in explaining the heterogeneity in Okun coefficients. As in BLL (2016), we find an association between the Okun coefficient and the mean unemployment rate. The other variable that plays a role is the share of services in GDP, consistent with suggestions from the literature, e.g. Kapsos (2006).

The rest of the paper is organized as follows. Section 2 reviews Okun's Law, Section 3 presents the main results and Section 4 delves into the determinants

of cross-country differences in Okun coefficients. Section 5 provides our tentative conclusions.

2 Okun's Law

Okun's Law is an inverse relationship between cyclical fluctuations in output and the unemployment rate. Shocks to the economy cause output to fluctuate around potential and lead firms to hire and fire workers, changing the unemployment rate in the opposite direction. This relation can be expressed as:

$$u_t - u_t^* = \beta\left(y_t - y_t^*\right) + \varepsilon_t \tag{1}$$

where u_t^* and y_t^* are the trend components of the unemployment rate and log output, respectively. The error term of Eq. (1) captures factors that shift the cyclical unemployment-output relationship, such as unusual changes in productivity or in labor force participation.

The coefficient β in Eq. (1) in turn depends on how much firms adjust employment when output changes and on the cyclical response of the labor force:

$$e_t - e_t^* = \beta^e\left(y_t - y_t^*\right) + \varepsilon_{et} \tag{2}$$

$$l_t - l_t^* = \beta^l\left(y_t - y_t^*\right) + \varepsilon_{lt} \tag{3}$$

where l_t^* and e_t^* are the trend values of the log of labor force and employment, respectively. The smaller is the cyclical response of the labor force, the stronger is the inverse correlation between β and β^e.

The data on the unemployment rate, employment, labor force and real GDP come from the IMF's *World Economic Outlook* database and are described in the Appendix. To measure the trend values of the unemployment rate, output, employment and the labor force, we use the Hodrick-Prescott (HP) filter. The smoothness parameter (λ) in the HP filter is set equal to 100 in our baseline results, but we check for sensitivity to an alternate value of $\lambda = 12$.[1]

Another version of Okun's Law posits a relationship between the changes in the unemployment rate and the growth rate of output:

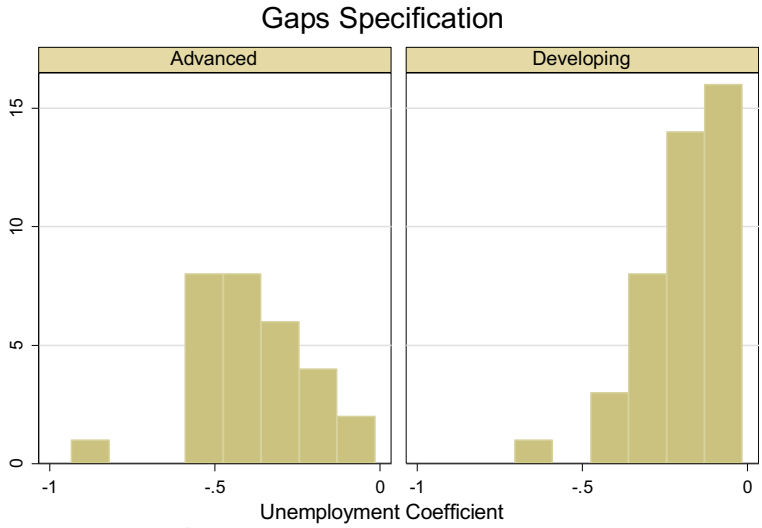
$$\Delta u_t = \alpha + \gamma \Delta y_t + \omega_t \tag{4}$$

The corresponding equations for employment growth and labor force growth are given as:

$$\Delta e_t = \alpha^e + \gamma^e \Delta y_t + \omega_{et} \tag{5}$$

$$\Delta l_t = \alpha^l + \gamma^l \Delta y_t + \omega_{lt} \tag{6}$$

[1] To address the well-known end-point problem with the HP filter we extend all series to 2021 using the IMF's World Economic Outlook projections and then run the HP filter on the extended series to derive the trend estimate for 2015.



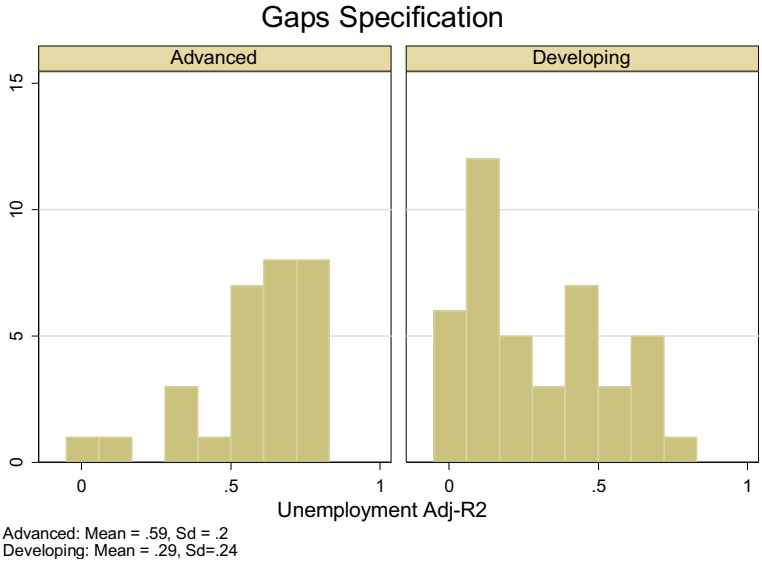
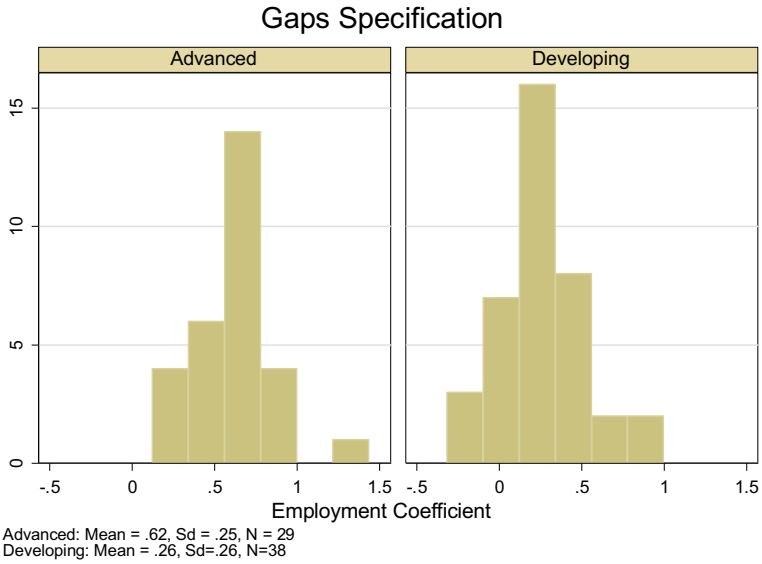


Fig. 1 Unemployment gaps equation: Histograms of β estimates and *Adj* R^2

In this paper we do not tackle the issue of whether the gap version or the changes version should be the preferred specification of Okun's Law. Often the changes version is used by authors because it does not require an explicit measurement of the trend components. But this is not a real solution because implicit assumptions about the trend components end up being subsumed in the constant term of Eq. (4) and in the error terms. We present evidence on both versions of Okun's Law and leave resolution of which one is more appropriate to future research.



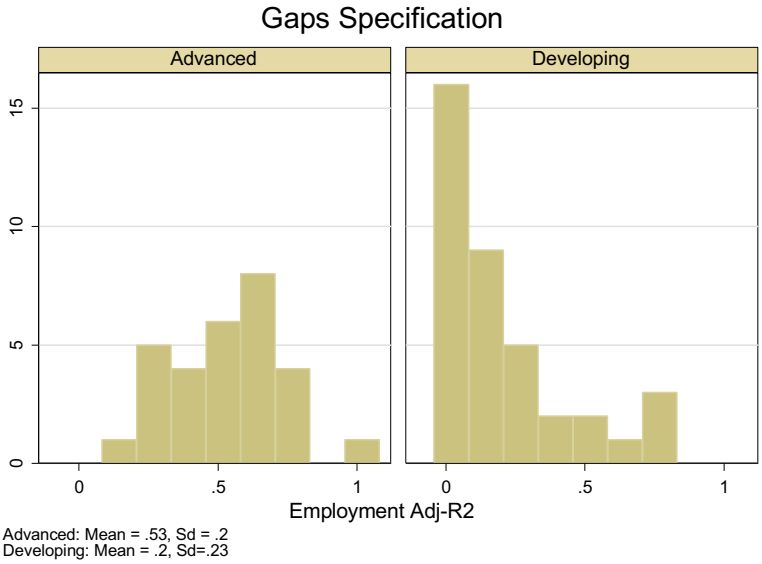
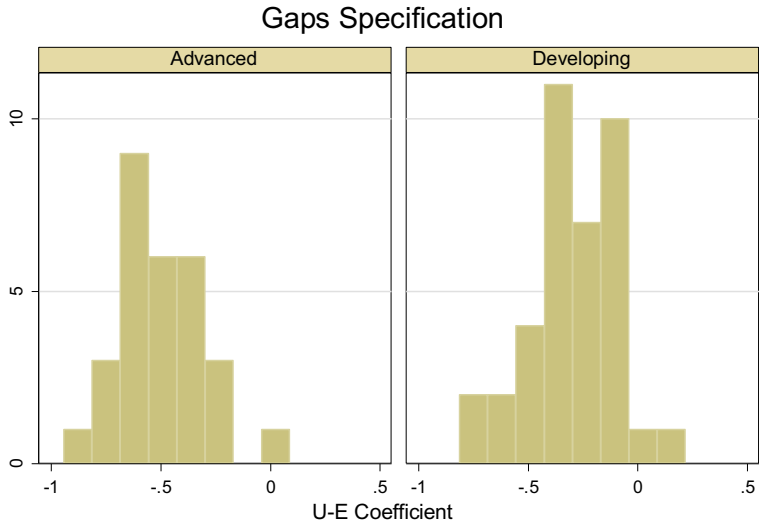


Fig. 2 Employment gap equations: Histograms of β^e estimates and *Adj* R^2

3 Main Results

3.1 Summary Statistics

The top panel of Fig. 1 shows the histogram for the estimated β coefficients for the two groups. The average value of the coefficient is −0.4 for advanced countries and − 0.2 for developing countries. For both groups there is considerable heterogeneity; the



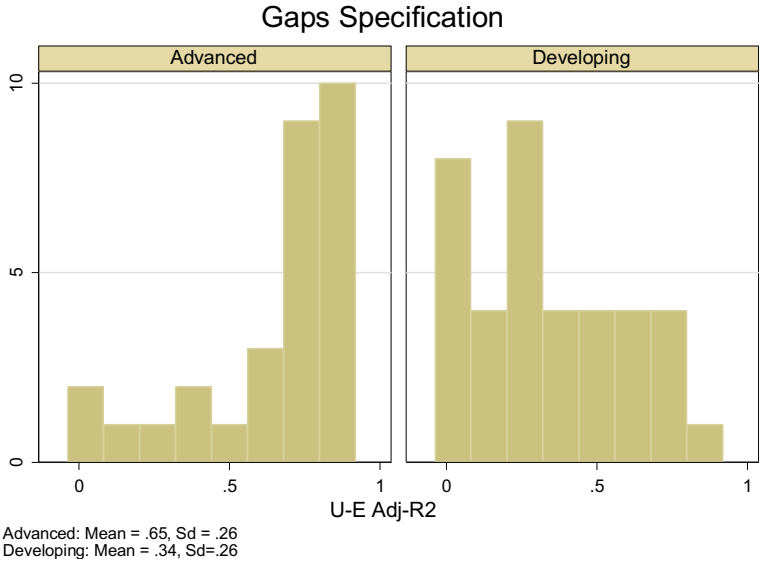


Fig. 3 Unemployment- Employment equation: Histograms of β^{U-E} estimates and $Adj\ R^2$

standard deviation is 0.18 and 0.14 for advanced and developing countries, respectively. The bottom panel provides evidence on the fit of Okun's Law as measured by the R-square statistic of the unemployment gap regressions. The average value in advanced countries is twice that in developing (0.6 compared with 0.3), but again with a lot of heterogeneity within each group.

This pattern of results broadly continues in Fig. 2, which shows the histograms of the β^e estimates and the R-square values of the employment gap regressions. The mean

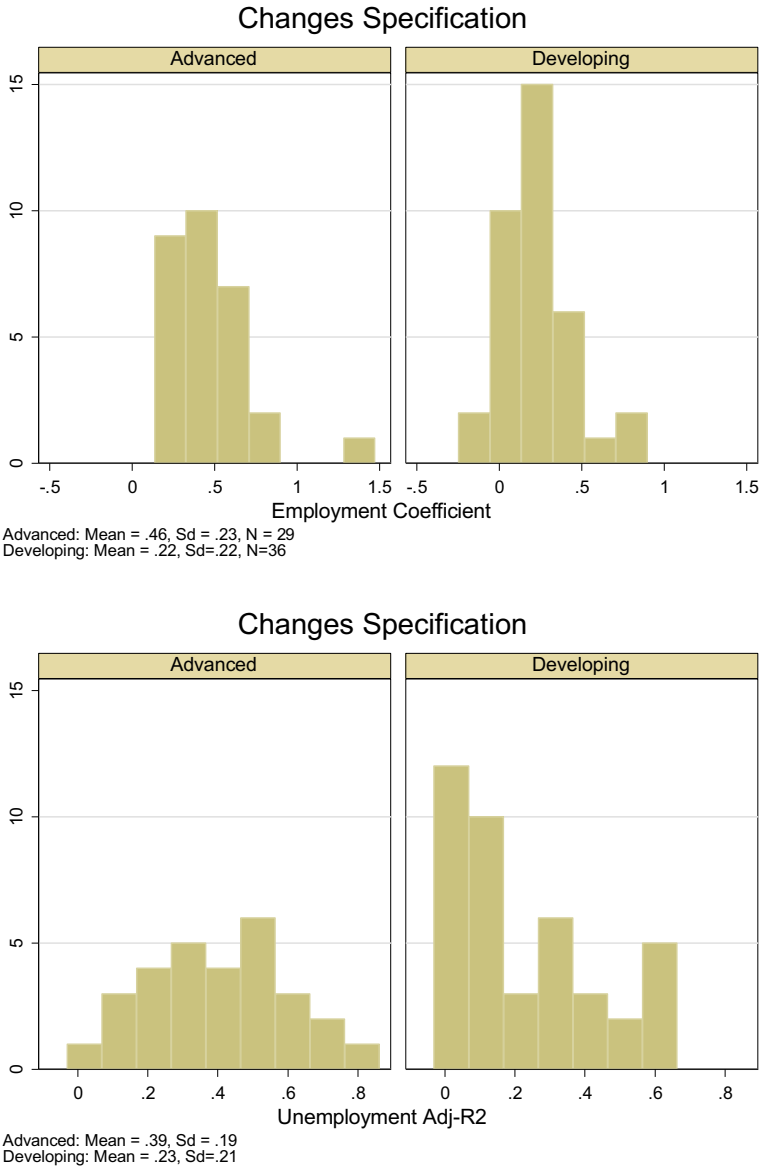
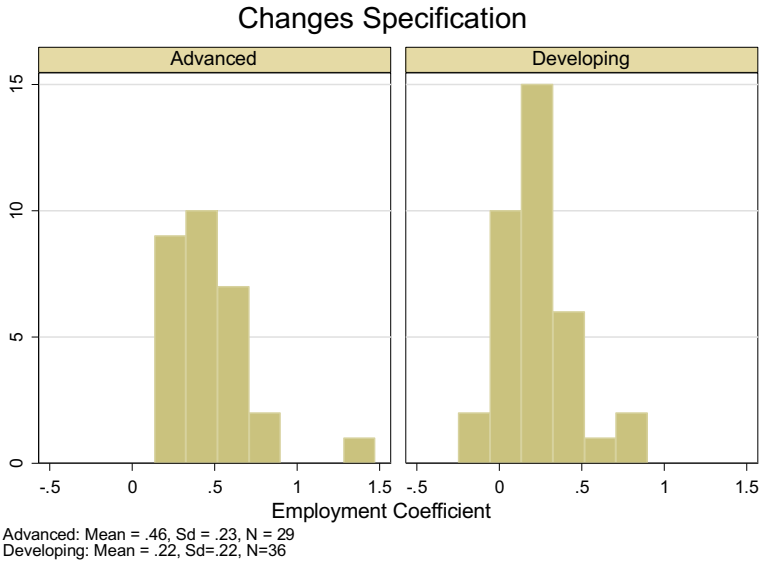


Fig. 4 Change in unemployment equation: Histograms of γ estimates and *Adj* R^2

value in advanced countries is a bit more than twice that in developing (0.6 vs. 0.25); the mean R-square value is also more than twice the value (0.5 vs. 0.2); and there is substantial variation within each country group as shown in the histograms and the reported standard deviations.

The distribution of β^l estimates is different in the two groups, as shown in the top panel of Fig. 3. In advanced countries, the coefficient is positive in all but two cases; in contrast, in developing countries, the distribution is centered on zero, with nearly as many positive β^l estimates as negative ones. The fit of these equations is quite low for



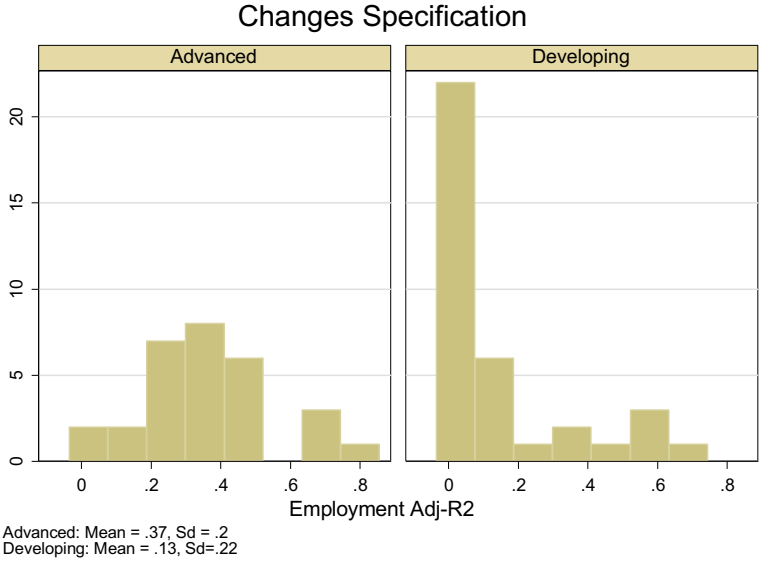


Fig. 5 Employment growth equation: Histograms of γ^e estimates and *Adj* R^2

both groups, as shown in the bottom panel of Fig. 3: the average R-square values are about 0.2 and 0.1 for advanced and developing countries, respectively.

To summarize, as a broad characterization, Okun's Law holds about half as well in developing countries as in advanced: the average β coefficient and average R-square value are both about half that in advanced countries. The weaker unemployment response to cyclical fluctuations in developing countries is partly because of a smaller employment response (β^e is smaller on average); in some cases

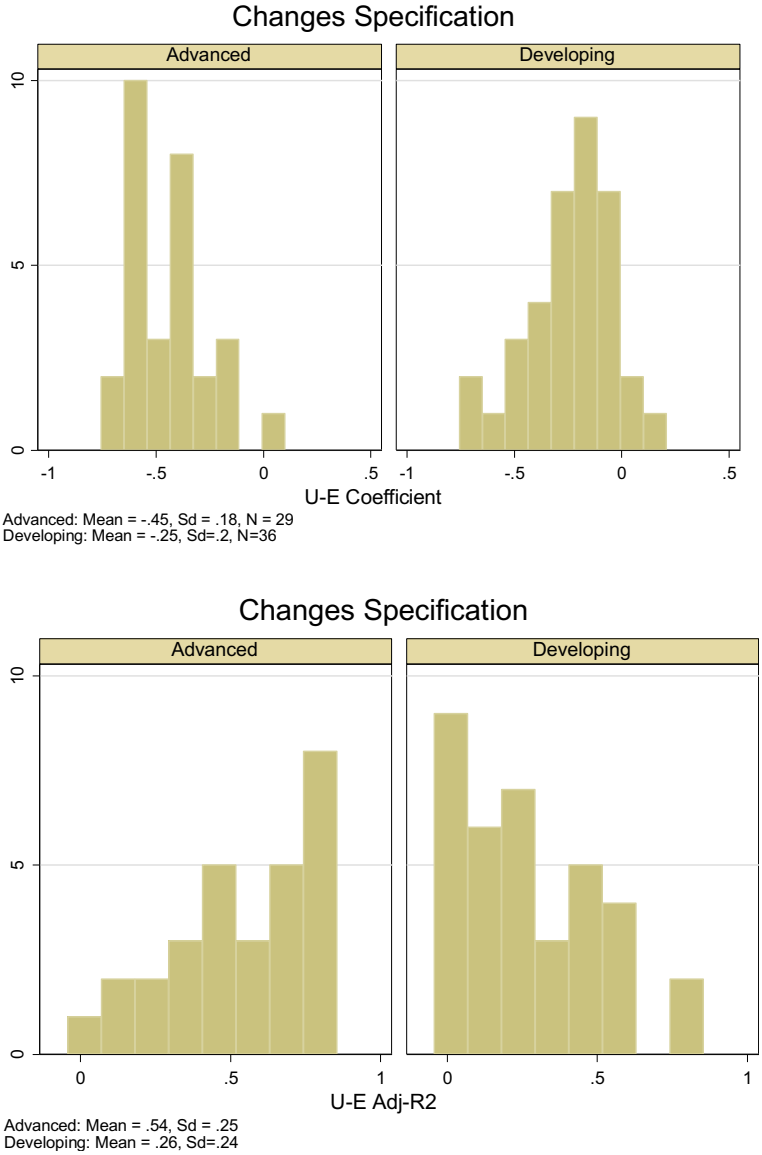


Fig. 6 Changes Unemployment- Employment equation. Histograms of γ^{U-E} estimates and *Adj* R^2

the countercyclical response of the labor force (negative value of β^l) adds to the weaker unemployment response.

Using the changes version of Okun's Law does not lead to a major change in this assessment. The histograms of the estimates of γ, γ^e and γ^l are shown in Figs. 4, 5 and 6, respectively. The mean values of the γ and γ^e coefficients are again much higher for advanced than for developing countries, though not quite twice as high as was the case with the gap version (see Figs. 4 and 5, top panels). The fit of the employment equation is not as good in the changes version as in the gap version (Fig. 5, bottom panel). The

Table 1 Okun's law coefficients: unemployment – gaps specification

Country	β	Adj-R2
Advanced		
Australia	−0.570***	0.831
Austria	−0.166**	0.149
Belgium	−0.516***	0.565
Canada	−0.440***	0.771
Czech Republic	−0.244***	0.552
Denmark	−0.448***	0.652
Finland	−0.482***	0.756
France	−0.315***	0.582
Germany	−0.370***	0.501
Greece	−0.508***	0.820
Hong Kong SAR	−0.209***	0.655
Ireland	−0.406***	0.761
Israel	−0.306***	0.338
Italy	−0.334***	0.381
Japan	−0.171***	0.694
Korea	−0.317***	0.664
Netherlands	−0.449***	0.706
New Zealand	−0.473***	0.622
Norway	−0.278***	0.539
Portugal	−0.427***	0.690
Puerto Rico	−0.537***	0.580
Singapore	−0.015	−0.019
Slovak Republic	−0.510***	0.804
Spain	−0.934***	0.827
Sweden	−0.493***	0.570
Switzerland	−0.313***	0.447
Taiwan Province of China	−0.104***	0.380
United Kingdom	−0.417***	0.637
United States	−0.518***	0.763
Developing		
Albania	−0.249***	0.426
Algeria	−0.257**	0.108
Argentina	−0.112**	0.093
Belarus	−0.062***	0.627
Brazil	−0.241***	0.468
Bulgaria	−0.291***	0.315
Chile	−0.356***	0.580
China	−0.015	−0.008
Colombia	−0.437***	0.751
Costa Rica	−0.231***	0.490
Croatia	−0.333***	0.391
Dominican Republic	−0.084**	0.118

Table 1 (continued)

Country	β	Adj-R2
Ecuador	−0.172**	0.120
Egypt	−0.425***	0.696
Georgia	−0.015	−0.051
Honduras	−0.096*	0.064
Hungary	−0.338***	0.696
Indonesia	−0.017	−0.025
Iran	−0.144*	0.072
Jordan	−0.175**	0.170
Kazakhstan	−0.131***	0.681
Kyrgyz Republic	−0.110	0.029
Malaysia	−0.118***	0.443
Mexico	−0.190***	0.214
Moldova	−0.195***	0.431
Morocco	−0.023	−0.039
Nicaragua	−0.154***	0.155
Pakistan	−0.187***	0.272
Panama	−0.241***	0.592
Paraguay	−0.108*	0.074
Peru	−0.123***	0.378
Philippines	−0.230***	0.224
Poland	−0.667***	0.522
Romania	−0.049	0.027
Russia	−0.161***	0.642
South Africa	−0.330***	0.158
Sri Lanka	−0.101***	0.338
Tunisia	−0.379***	0.270
Turkey	−0.100**	0.121
Ukraine	−0.057*	0.112
Uruguay	−0.218***	0.431
Vietnam	−0.297**	0.159

*, **, and *** denote significance at 10, 5 and 1 % respectively

distribution of γ^l and the fit of the labor force equation is quite similar in the changes and gap versions (Fig. 6).

While useful, a focus only on the averages misses the substantial heterogeneity illustrated in the histograms. Understanding some of the sources of this heterogeneity requires a closer look at the country-by-country estimates. We turn to this in the next sub-section and in Section 4.

3.2 Estimates by Country

The country estimates that underlie Figures 1, 2, 3, 4 and 5, and 66 are given in Tables 1, 2, 3, 4, 5, and 6. The main points from these tables are the following:

Table 2 Okun's law coefficients: employment – gaps specification

Country	β^e	Adj-R2
Advanced		
Australia	0.828***	0.547
Austria	0.521***	0.332
Belgium	0.615***	0.665
Canada	0.650***	0.749
Czech Republic	0.326***	0.591
Denmark	0.582***	0.415
Finland	0.726***	0.744
France	0.416***	0.341
Germany	0.573***	0.664
Greece	0.724***	0.691
Hong Kong SAR	0.189**	0.127
Ireland	0.822***	0.791
Israel	0.713***	0.492
Italy	0.516***	0.525
Japan	0.245***	0.317
Korea	0.589***	0.505
Netherlands	0.646***	0.560
New Zealand	0.954***	0.700
Norway	0.641***	0.359
Portugal	0.724***	0.591
Puerto Rico	0.825***	0.346
Singapore	0.486***	0.322
Slovak Republic	0.439***	0.695
Spain	1.436***	0.957
Sweden	0.640***	0.472
Switzerland	0.470***	0.266
Taiwan Province of China	0.149***	0.272
United Kingdom	0.680***	0.652
United States	0.722***	0.805
Developing		
Albania	0.411***	0.273
Algeria	0.262	0.047
Argentina	0.186**	0.165
Belarus	0.184***	0.340
Brazil	0.135*	0.054
Bulgaria	0.432**	0.171
Chile	0.457***	0.521
China	−0.035***	0.290
Colombia	0.214	0.031
Costa Rica	0.200	0.017
Croatia	0.387***	0.256
Ecuador	0.415	0.018

Table 2 (continued)

Country	β^e	Adj-R2
Egypt	0.829***	0.727
Georgia	−0.244	0.023
Honduras	0.246*	0.070
Hungary	0.652***	0.629
Indonesia	−0.036	−0.026
Iran	0.313**	0.175
Jordan	0.209***	0.330
Kazakhstan	0.422***	0.788
Kyrgyz Republic	0.057	−0.033
Malaysia	0.121	0.024
Mexico	0.279***	0.191
Moldova	−0.033	−0.042
Morocco	−0.317*	0.105
Nicaragua	0.524**	0.088
Pakistan	0.340	0.048
Panama	0.259***	0.252
Peru	−0.026	−0.019
Philippines	0.307**	0.160
Poland	0.677***	0.460
Russia	0.381***	0.776
South Africa	0.835**	0.117
Tunisia	0.326*	0.075
Turkey	−0.159	0.004
Ukraine	0.284***	0.350
Uruguay	0.336***	0.175
Vietnam	−0.089	−0.026

*, **, and *** denote significance at 10, 5 and 1 % respectively

- For advanced economies, with only one exception (Singapore), the estimates of β are all negative and significantly different from zero; for developing economies, the Okun coefficient is negative and significant in 36 out of 42 cases (Table 1). Okun's Law appears to hold well in Poland and Colombia, with Okun coefficients of about −0.7 and − 0.4, respectively, and R-square values that exceed 0.4. For South Africa, the coefficient is −0.33, but the R-square value is low (0.16). For Russia, Okun's law fits well but with a small coefficient, about −0.15.
- For advanced economies, the coefficient estimate of β^e is positive and significant in all cases; for developing economies, the coefficient is positive in 30 out of 38 cases and significant in 23 of them (Table 2). The largest coefficients are for South Africa and Egypt (both exceeding 0.8), though the R-square is low in the former case and high in the latter. Poland, Hungary and Chile are other countries with high coefficients and reasonably good fit.
- Table 3 presents estimates of the cyclical response of the labor force. In advanced countries, the coefficient estimates are positive in all but two cases, and

Table 3 Okun's law coefficients: unemployment-employment – gaps specification

Country	$\beta^{U\text{-}E}$	Adj-R2
Advanced		
Australia	−0.495***	0.767
Austria	−0.183**	0.139
Belgium	−0.798***	0.765
Canada	−0.610***	0.829
Czech Republic	−0.719***	0.857
Denmark	−0.520***	0.693
Finland	−0.633***	0.919
France	−0.428***	0.515
Germany	−0.662***	0.799
Greece	−0.597***	0.850
Hong Kong SAR	−0.287***	0.279
Ireland	−0.425***	0.689
Israel	−0.317***	0.368
Italy	−0.609***	0.646
Japan	−0.368***	0.567
Korea	−0.379***	0.632
Netherlands	−0.580***	0.862
New Zealand	−0.448***	0.723
Norway	−0.326***	0.823
Portugal	−0.457***	0.687
Puerto Rico	−0.430***	0.699
Singapore	0.019	−0.018
Slovak Republic	−0.943***	0.744
Spain	−0.654***	0.874
Sweden	−0.675***	0.915
Switzerland	−0.170*	0.079
Taiwan Province of China	−0.358***	0.335
United Kingdom	−0.581***	0.873
United States	−0.695***	0.887
Developing		
Albania	−0.398***	0.639
Algeria	−0.401***	0.282
Argentina	−0.653***	0.635
Belarus	−0.149**	0.230
Brazil	−0.509***	0.473
Bulgaria	−0.465***	0.795
Chile	−0.674***	0.824
China	−0.120	−0.021
Colombia	−0.231**	0.142
Costa Rica	−0.137**	0.138

Table 3 (continued)

Country	$\beta^{U\text{-}E}$	Adj-R2
Croatia	−0.212	0.048
Ecuador	−0.091**	0.105
Egypt	−0.406***	0.587
Georgia	−0.322***	0.559
Honduras	−0.233***	0.314
Hungary	−0.404***	0.658
Indonesia	−0.405***	0.405
Iran	−0.431***	0.434
Jordan	−0.720***	0.392
Kazakhstan	−0.285***	0.720
Kyrgyz Republic	−0.220	0.022
Malaysia	−0.110*	0.076
Mexico	−0.370***	0.308
Moldova	−0.372***	0.270
Morocco	−0.064	−0.001
Nicaragua	−0.069*	0.061
Pakistan	−0.167***	0.303
Panama	−0.322***	0.244
Peru	0.089	−0.014
Philippines	−0.233**	0.101
Poland	−0.791***	0.715
Russia	−0.400***	0.736
South Africa	−0.212***	0.352
Tunisia	−0.501***	0.482
Turkey	−0.156***	0.264
Ukraine	−0.165**	0.237
Uruguay	−0.305***	0.480
Vietnam	0.046	−0.037

*, **, and *** denote significance at 10, 5 and 1 % respectively

significantly so in 20 cases. For developing countries, the coefficients are positive in about half the cases, though often not significant. For both groups the R-square coefficients are fairly low.

- Tables 4, 5 and 6 provide the estimates of γ, γ^e and γ^l. These do not substantively alter the main points given above. One difference, as already noted, is that the changes version of the employment equation does not fare as well as the gap version: fewer estimates of γ^e are significant and the fit of the equation is worse.

Table 7 classifies countries into a 3 × 3 matrix based on the absolute values of β and the R-square statistic. In 18 countries, Okun's Law does poorly on both dimensions. In the other cells, the performance improves along at least of the dimensions. Figure 7

Table 4 Okun's law coefficients: unemployment – changes specification

Country	γ	Adj-R2
Advanced		
Australia	−0.508***	0.691
Austria	−0.136**	0.145
Belgium	−0.337***	0.337
Canada	−0.418***	0.763
Czech Republic	−0.243***	0.352
Denmark	−0.343***	0.505
Finland	−0.345***	0.515
France	−0.237***	0.305
Germany	−0.230***	0.284
Greece	−0.361***	0.583
Hong Kong SAR	−0.168***	0.407
Ireland	−0.341***	0.576
Israel	−0.200**	0.139
Italy	−0.183***	0.201
Japan	−0.070***	0.218
Korea	−0.159***	0.409
Netherlands	−0.312***	0.507
New Zealand	−0.314***	0.260
Norway	−0.190***	0.268
Portugal	−0.330***	0.467
Puerto Rico	−0.261***	0.217
Singapore	−0.012	−0.027
Slovak Republic	−0.349***	0.393
Spain	−0.809***	0.698
Sweden	−0.364***	0.468
Switzerland	−0.259***	0.369
Taiwan Province of China	−0.058**	0.156
United Kingdom	−0.367***	0.522
United States	−0.426***	0.632
Developing		
Albania	−0.154**	0.104
Algeria	−0.303**	0.113
Argentina	−0.211***	0.324
Belarus	−0.056***	0.490
Brazil	−0.188***	0.226
Bulgaria	−0.248***	0.318
Chile	−0.400***	0.630
China	−0.002	−0.030
Colombia	−0.412***	0.614
Costa Rica	−0.226***	0.366
Croatia	−0.166**	0.136
Dominican Republic	−0.064	0.030

Table 4 (continued)

Country	γ	Adj-R2
Ecuador	−0.269*	0.085
Egypt	−0.328***	0.329
Honduras	0.003	−0.030
Hungary	−0.322***	0.628
Indonesia	−0.041	−0.008
Iran	−0.180**	0.140
Jordan	−0.141*	0.082
Kazakhstan	−0.115***	0.490
Kyrgyz Republic	−0.119	0.055
Malaysia	−0.105***	0.441
Mexico	−0.208***	0.440
Moldova	−0.239***	0.586
Morocco	−0.042	−0.008
Nicaragua	−0.133**	0.123
Pakistan	−0.060	−0.010
Panama	−0.226***	0.421
Paraguay	−0.118	0.045
Peru	−0.104**	0.117
Philippines	−0.175**	0.121
Poland	−0.527***	0.344
Romania	−0.058	0.037
Russia	−0.146***	0.576
South Africa	−0.249*	0.061
Sri Lanka	−0.067**	0.168
Tunisia	−0.337***	0.230
Turkey	−0.114***	0.214
Ukraine	−0.040	−0.012
Uruguay	−0.204***	0.318
Vietnam	−0.169	−0.001

*, **, and *** denote significance at 10, 5 and 1 % respectively

illustrates four cases—Colombia, Egypt, Poland and Russia—where Okun's Law appears to hold well.

4 Determinants of Okun Coefficients

In this section we look into some of the factors that are associated with the cross-country variation in β and β^e. The seven factors we consider are those suggested by previous studies. We first present a set of scatter plots to show the bivariate relationship between β and each of the seven factors (Figs. 8, 9, 10, 11, 12, 13, and 14). In each figure, we show the slope of the estimated relationship for the full sample as well as separately for the advanced and developing country groups.

Table 5 Okun's law coefficients: employment – changes specification

Country	γ^e	Adj-R2
Advanced		
Australia	0.631***	0.413
Austria	0.309***	0.244
Belgium	0.394***	0.344
Canada	0.599***	0.734
Czech Republic	0.234**	0.217
Denmark	0.450***	0.293
Finland	0.538***	0.515
France	0.212*	0.074
Germany	0.333***	0.346
Greece	0.562***	0.388
Hong Kong SAR	0.213***	0.235
Ireland	0.743***	0.688
Israel	0.425***	0.211
Italy	0.252***	0.251
Japan	0.251***	0.500
Korea	0.364***	0.481
Netherlands	0.516***	0.427
New Zealand	0.635***	0.377
Norway	0.351**	0.140
Portugal	0.578***	0.413
Puerto Rico	0.733***	0.399
Singapore	0.346**	0.157
Slovak Republic	0.315**	0.225
Spain	1.282***	0.857
Sweden	0.474***	0.340
Switzerland	0.235*	0.062
Taiwan Province of China	0.161***	0.308
United Kingdom	0.495***	0.396
United States	0.630***	0.736
Developing		
Albania	0.159	0.009
Algeria	0.084	−0.027
Argentina	0.230**	0.147
Belarus	0.228***	0.613
Brazil	0.093	−0.006
Bulgaria	0.448***	0.309
Chile	0.459***	0.495
China	0.019	−0.030
Colombia	0.300	0.039
Costa Rica	0.048	−0.028

Table 5 (continued)

Country	γ^e	Adj-R2
Croatia	0.166	−0.003
Ecuador	0.271	−0.032
Egypt	0.864***	0.656
Honduras	−0.020	−0.030
Hungary	0.554***	0.407
Indonesia	−0.029	−0.036
Iran	0.184	0.038
Jordan	0.205***	0.219
Kazakhstan	0.456***	0.624
Kyrgyz Republic	0.052	−0.024
Malaysia	0.249**	0.146
Mexico	0.169	0.047
Moldova	0.143	−0.007
Nicaragua	0.311	0.009
Pakistan	−0.247	−0.023
Panama	0.221**	0.105
Peru	0.043	−0.013
Philippines	0.088	−0.023
Poland	0.419**	0.170
Russia	0.351***	0.623
South Africa	0.752*	0.066
Tunisia	0.243	0.046
Turkey	−0.110	−0.010
Ukraine	0.231**	0.162
Uruguay	0.346**	0.103
Vietnam	0.072	−0.033

*, **, and *** denote significance at 10, 5 and 1 % respectively

- *Mean unemployment rate:* BLL (2017) document a positive relationship for advanced countries between the estimated Okun's coefficient and the average level of unemployment: in countries where unemployment is higher on average, it also fluctuates more in response to output movements. While the reason for this association is not apparent, we find that a similar correlation holds for developing economies as well (Fig. 8).
- Per capita *GDP*: The histograms showed a difference between the average values of the Okun coefficients between advanced and developing countries. Since the segmentation of the countries in the two groups was based on income, per capita GDP is an obvious candidate to explain some of the cross-country heterogeneity. As shown in Fig. 9, for both the overall sample and for the developing countries group, there is a negative relationship between per capita GDP and the Okun coefficient: in countries with higher per capita GDP, unemployment is more responsive to output fluctuations. However, the relationship does not hold for countries in the advanced country group.

Table 6 Okun's law coefficients: unemployment employment – changes specification

Country	$\gamma^{U\text{-}E}$	Adj-R2
Advanced		
Australia	−0.551***	0.758
Austria	−0.293***	0.263
Belgium	−0.623***	0.506
Canada	−0.618***	0.808
Czech Republic	−0.756***	0.779
Denmark	−0.445***	0.552
Finland	−0.593***	0.855
France	−0.376***	0.345
Germany	−0.643***	0.721
Greece	−0.391***	0.529
Hong Kong SAR	−0.392***	0.391
Ireland	−0.388***	0.567
Israel	−0.191**	0.088
Italy	−0.557***	0.466
Japan	−0.190***	0.195
Korea	−0.377***	0.632
Netherlands	−0.457***	0.663
New Zealand	−0.486***	0.681
Norway	−0.340***	0.685
Portugal	−0.376***	0.470
Puerto Rico	−0.336***	0.498
Singapore	0.035	−0.009
Slovak Republic	−0.642***	0.515
Spain	−0.631***	0.814
Sweden	−0.613***	0.854
Switzerland	−0.195**	0.108
Taiwan Province of China	−0.296***	0.350
United Kingdom	−0.582***	0.793
United States	−0.659***	0.814
Developing		
Albania	−0.410***	0.601
Algeria	−0.284***	0.242
Argentina	−0.573***	0.496
Belarus	−0.189***	0.382
Brazil	−0.414***	0.422
Bulgaria	−0.487***	0.784
Chile	−0.706***	0.821
China	0.102	−0.001
Colombia	−0.207***	0.187
Costa Rica	−0.052	−0.010
Croatia	0.047	−0.038
Ecuador	−0.053	0.003
Egypt	−0.272***	0.242
Honduras	−0.153**	0.119

Table 6 (continued)

Country	$\gamma^{U\text{-}E}$	Adj-R2
Hungary	−0.365***	0.580
Indonesia	−0.335***	0.320
Iran	−0.308**	0.188
Jordan	−0.488***	0.206
Kazakhstan	−0.191***	0.429
Kyrgyz Republic	−0.155	−0.035
Malaysia	−0.117**	0.172
Mexico	−0.206**	0.144
Moldova	−0.252***	0.376
Nicaragua	−0.089**	0.143
Pakistan	−0.052	0.011
Panama	−0.279***	0.224
Peru	0.034	−0.028
Philippines	−0.189*	0.074
Poland	−0.676***	0.502
Russia	−0.323***	0.538
South Africa	−0.263***	0.582
Tunisia	−0.526***	0.416
Turkey	−0.103**	0.095
Ukraine	−0.112	0.033
Uruguay	−0.183***	0.224
Vietnam	−0.039	−0.042

*, **, and *** denote significance at 10, 5 and 1 % respectively

Table 7 Classification of countries by fit of Okun's law

	Adj-R2		
	Smaller than developing countries average	Higher than developing countries average but smaller than advanced countries average	Higher than advanced countries average
β Higher than advanced countries average (in absolute value)		Poland	Colombia, Egypt
Higher than developing countries average but smaller than advanced countries average (in absolute value)	Algeria, Philippines, South Africa, Tunisia, Vietnam	Albania, Brazil, Bulgaria, Chile, Costa Rica, Croatia, Panama, Uruguay	Hungary
Smaller than developing countries average (in absolute value)	Argentina, China, Dominican Republic, Ecuador, Georgia, Honduras, Indonesia, Iran, Jordan, Kyrgyz Republic, Mexico, Morocco, Nicaragua, Pakistan, Paraguay, Romania, Turkey, Ukraine	Malaysia, Moldova, Peru, Sri Lanka	Belarus, Kazakhstan, Russia

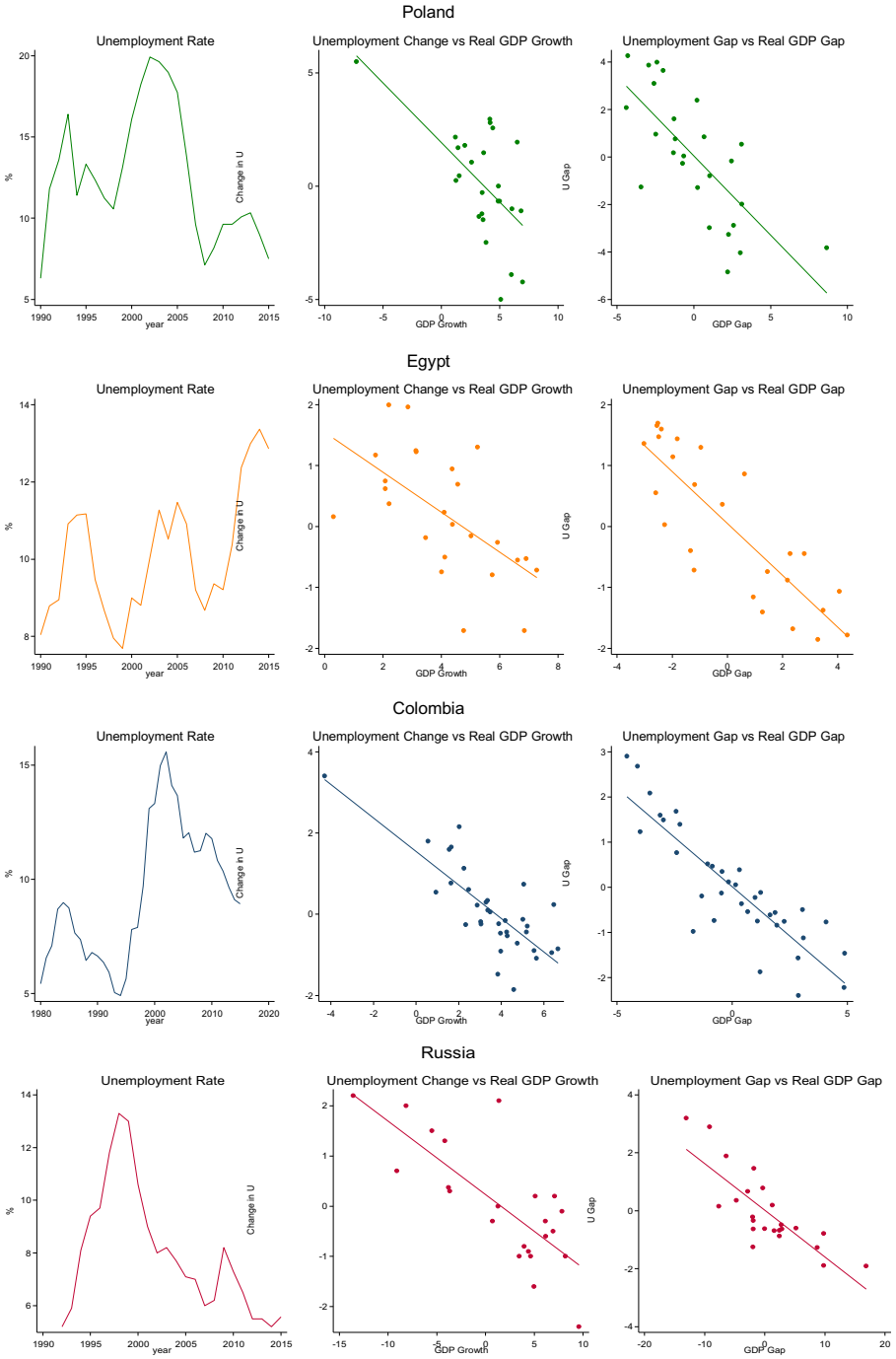


Fig. 7 Country Cases: Colombia, Egypt, Poland and Russia

- *Size of the shadow or informal sector:* Agénor and Montiel (2008) and Mohommad et al. (2012) discuss the importance of the shadow or informal economy in

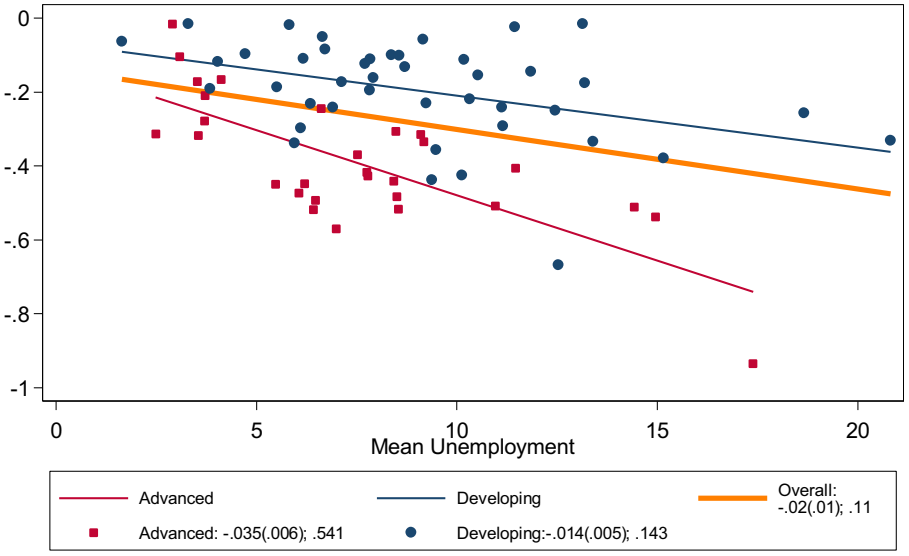


Fig. 8 β vs average unemployment

developing economies; the existence of this sector can obscure relationships between the formal labor market and measured output, thus lowering the measured Okun coefficient. This view finds some confirmation in the data: Fig. 10 shows that for the full sample of countries, labor market and output fluctuations are less correlated in countries with larger shadow economies.

- *Share of services in GDP:* Kapsos (2006) and Furceri et al. (2012) document that in countries where the service share is higher, employment tends to be more

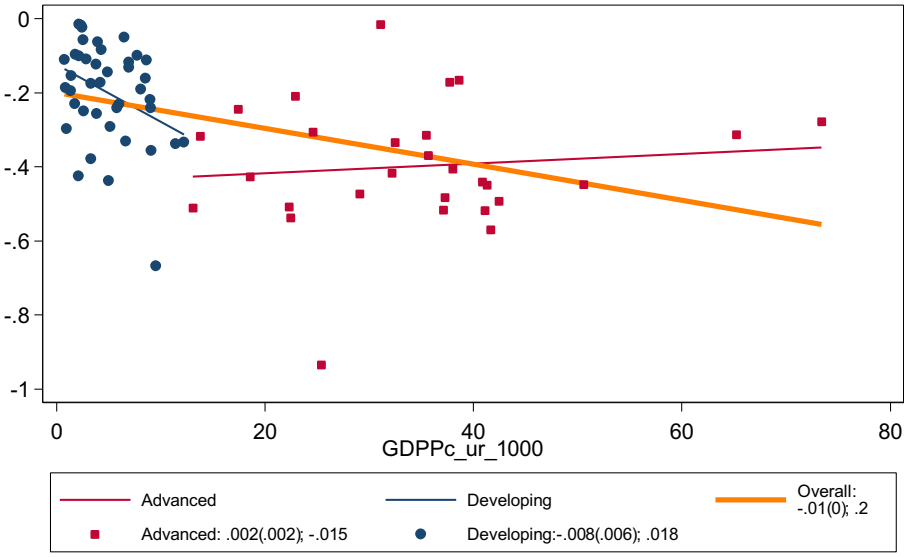
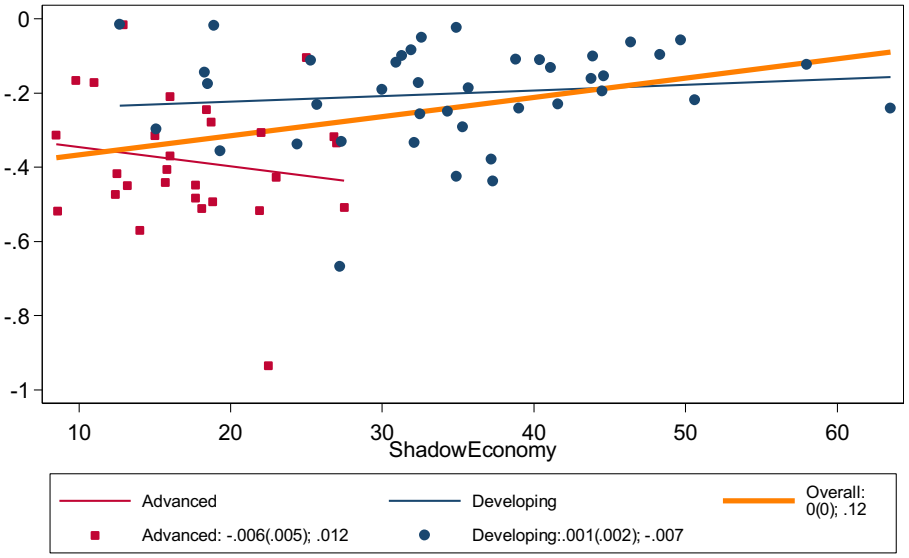


Fig. 9 β vs GDP per capita in thousands of 2010 dollars

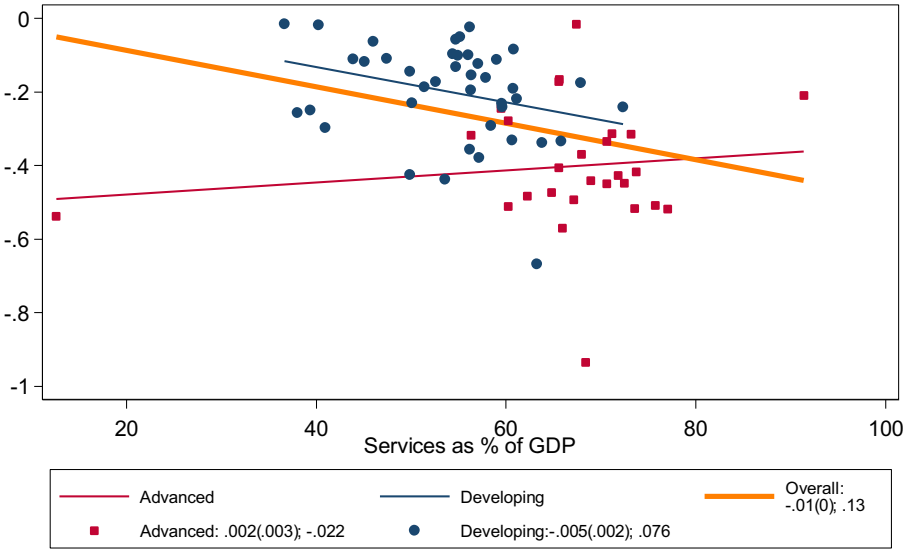


Note: coefficient(standar error); R-squared.

Fig. 10 β vs size of the shadow economy in %

responsive in changes in output. We find a similar association for the full sample and for developing countries (Fig. 11).

- *Skill mismatch*: Estevão and Tsounta (2011) suggest that skill mismatches can play a role in influencing how unemployment responds to shocks and present evidence supporting this from U.S. states. They measure skill mismatch as the difference between the skills embodied in the employment structure of a state ("demand") and



Note: coefficient(standar error); R-squared.

Fig. 11 β vs Services as % of GDP

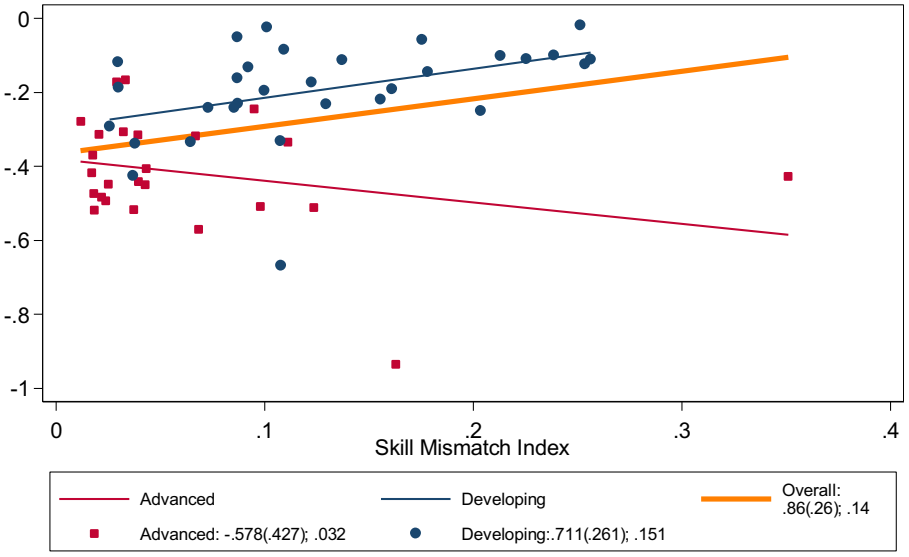


Fig. 12 β vs skill mismatch index

the skills reflected in the educational attainment of the state's labor force ("supply"). Melina (2016) constructs similar measures of skill mismatch for many of the countries in our sample. We find that, for developing countries in particular, higher skill mismatch is associated with a weaker response of unemployment to output (Fig. 12).

- *Labor market and business regulations:* Many observers suggest that the responsiveness of labor markets could depend on regulations governing labor and product

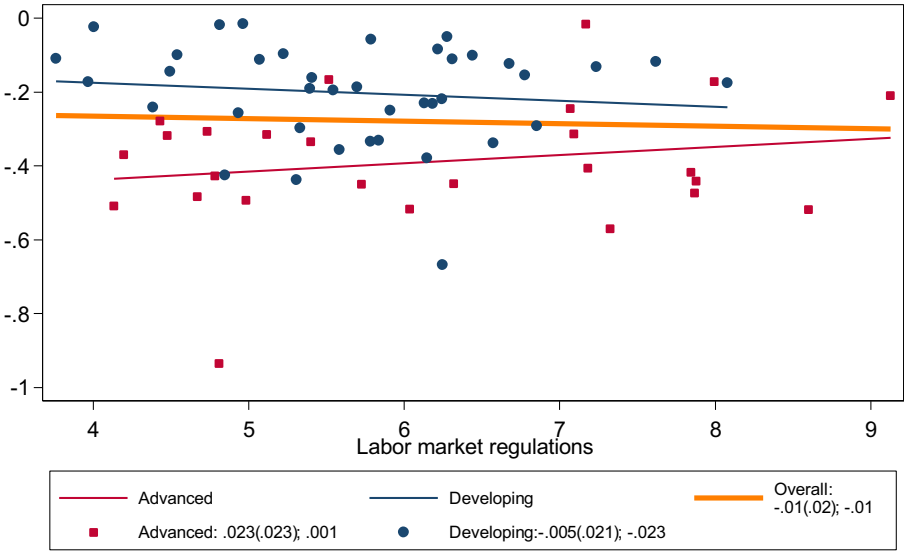


Fig. 13 β vs labor market regulations

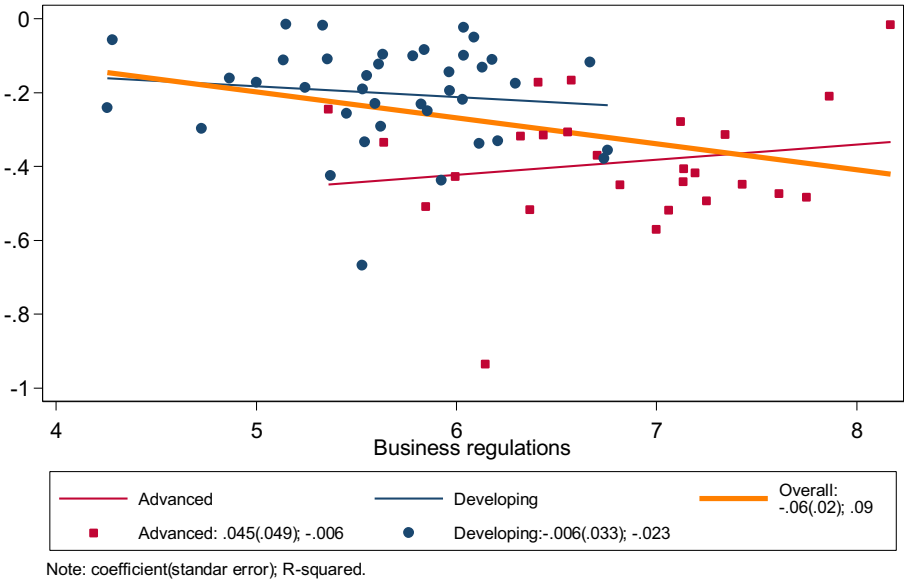


Fig. 14 β vs business regulations

markets. For instance, in discussing hiring and firing regulations in Middle Eastern and North African countries, Ahmed et al. (2012) argue that such regulations can discourage "firms from expanding employment in response to favorable changes in the economic climate." That is, greater employment protection can dampen hiring and firing as output fluctuates, reducing the employment responsiveness. We find little association between the Okun coefficient and aggregate measures of either labor market flexibility (Fig. 13) or product market flexibility (Fig. 14). Looking at individual components of these aggregate measures could yield stronger results; we plan to investigate this in future work.

Table 8 Correlation of determinants

	GDP per Capita (Thousands of constant USD)	% of Services in GDP	% of Shadow Economy	Skill mismatch index	Business regulations (Index 1–10)	Labor market regulations (Index 1–10)
% of Services in GDP	0.5282*	1				
% of Shadow Economy	−0.6489*	−0.3467*	1			
Skill mismatch index	−0.5558*	−0.4210*	0.4834*	1		
Business regulations (Index 1–10)	0.6914*	0.5645*	−0.5838*	−0.4778*	1	
Labor market regulations (Index 1–10)	0.1892	0.3753*	−0.2136	−0.2902*	0.4378*	1
Average Unemployment rate	−0.2795*	−0.139	0.2374*	0.2446	−0.1948	−0.1427

*, **, and *** denote significance at 10, 5 and 1 % respectively

Table 9 Determinants of the Okun coefficients

	β			γ		
GDP per capita (thousands of usd)	−0.00149	0.00123		0.00499	0.000441	
	(0.00215)	(0.00227)		(0.00398)	(0.00426)	
Services as % of GDP	−0.00764**	−0.0113***	−0.00586***	0.00494	0.0105*	0.00902***
	(0.00298)	(0.00317)	(0.00160)	(0.00550)	(0.00595)	(0.00297)
ShadowEconomy	0.00217	0.00191		−0.00555	−0.00536	
	(0.00235)	(0.00265)		(0.00452)	(0.00510)	
Skill Mismatch Index	0.133	0.0760		−0.494	−0.329	
	(0.277)	(0.312)		(0.540)	(0.608)	
Business regulations	−0.0279	−0.0476		0.0169	0.0459	
	(0.0373)	(0.0417)		(0.0706)	(0.0792)	
Labor market regulations	0.00386	0.0137		0.0105	−0.00959	
	(0.0168)	(0.0187)		(0.0326)	(0.0363)	
Mean Unemployment	−0.0219***		−0.0199***		0.0405***	0.0233**
	(0.00595)		(0.00492)		(0.0112)	(0.00895)
Constant	0.456	0.521	0.233**	−0.257	−0.257	−0.323
	(0.298)	(0.336)	(0.110)	(0.570)	(0.644)	(0.207)
Observations	53	53	68	51	51	66
R-squared	0.574	0.445	0.286	0.488	0.333	0.179
Adjusted R-squared	0.507	0.372	0.264	0.405	0.242	0.153

Table 8 shows correlations among the explanatory variables and Table 9 reports regression results. When all variables are entered in the regression together, only the effects of average unemployment and the share of services are statistically significant, as shown in the first column of the regression. Dropping the mean unemployment rate—on the grounds that it is not truly a causal factor—does not change things much (second column). The third includes only the average unemployment and the share of services; this regression has an adjusted R-square of 0.5, not much lower than the one in the first column. The three other column of the Table repeat the exercise for β^e, reaching broadly similar results, though in this case the difference in R-square values between the regression with all variables and the one with only two variables is more pronounced (0.48 vs. 0.33).

5 Conclusions

The structural challenges facing labor markets in developing economies deservedly get a lot of attention. In many of these economies, unemployment rates, and particularly youth unemployment rates, are alarmingly high. Others face the challenge of raising labor force participation, particularly among women. The results of this paper lend support to a focus on policies to address these structural challenges relative to the

cyclical considerations that are more dominant in advanced economies. We find that the cyclical relationship between jobs and growth is considerably weaker, on average, in developing than in advanced economies. At the same time, the finding of a significant Okun's Law relationship in many developing countries suggests that cyclical considerations should not be ignored. Aggregate demand policies that support output growth in the short term are also needed to keep many of these economies operating closer to full employment.

Acknowledgements We are grateful to Nathalie Gonzalez Prieto, Zidong An, Ezgi Ozturk and Jair Rodriguez for excellent research assistance. The views expressed in this paper are those of the authors and do not necessarily represent those of the IMF or IMF policy.

Appendix

Data Appendix

Table 10 List of countries included in the estimation

Advanced		Developing	
Australia	Korea	Albania	Kyrgyz Republic(1994)
Austria	Netherlands	Algeria	Malaysia(1985)
Belgium	New Zealand	Argentina	Mexico
Canada	Norway	Belarus(1991)	Moldova(1993)
Czech Republic(1995)	Portugal	Brazil	Morocco(1995)
Denmark	Puerto Rico	Bulgaria(1989)	Nicaragua
Finland	Singapore	Chile	Pakistan(1983)
France	Slovak Republic(1993)	China	Panama
Germany	Spain	Colombia	Paraguay(1983)
Greece	Sweden	Costa Rica	Peru
Hong Kong SAR	Switzerland	Croatia(1992)	Philippines(1985)
Ireland(1985)	Taiwan Province of China	Dominican Republic(1991)	Poland(1990)
Israel	United Kingdom	Ecuador(1988)	Romania(1985)
Italy	United States	Egypt(1990)	Russia(1992)
Japan		Georgia(1996)	South Africa
		Honduras	Sri Lanka(1990)
		Hungary	Tunisia(1990)
		Indonesia(1984)	Turkey
		Iran(1990)	Ukraine(1995)
		Jordan(1984–2014)	Uruguay(1983)
		Kazakhstan(1994)	Vietnam(1990)

Output

GDP data comes from the July 2016 version of the WEO. It corresponds to real GDP in national currency.

- $y_t - y_t^*$: cycle after filtering the logarithm of the GDP multiplied by 100, with a Hodrick-Prescott filter with lambda 100.
- Δy_t: Percentage change in GDP = 100* ln $(\frac{y_t}{y_{t-1}})$

Labor market statistics

Labor market data comes from the WEO. This data is internally reported by the desk economist and follows the standard ILO when available. In other cases, it can follow the national definition.

$e_t - e_t^*$: cycle after filtering the logarithm of the employment multiplied by 100, with a Hodrick-Prescott filter with lambda of 100.
$u_t - u_t^*$ cycle after filtering the unemployment rate with a Hodrick-Prescott filter, with lambda of 100
$lf_t - lf_t^*$ cycle after filtering the logarithm of the labor force multiplied by 100, with a Hodrick-Prescott filter with lambda of 100

Determinants of the Okun Coefficient

Average Unemployment Average unemployment rate from the WEO for the period covered in each regression. The number of periods used to compute the average can vary depending on the country. This indicator comes from national sources that use household surveys and follow the ILO definition of unemployment: unemployed comprise all persons above a specified age who during the reference period were:

– Without work, that is, were not in paid employment or self-employment during the reference period;
– Currently available for work, that is, were available for paid employment or self-employment during the reference period; and
– Seeking work, that is, had taken specific steps in a specified recent period to seek paid employment or self-employment.

This means that the unemployment rate does not include the informal workers as unemployed.
GDP per capita: is gross domestic product divided by midyear population. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated

without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in constant 2010 U.S. dollars. Average of the period used in the regression to estimate the coefficients ($\beta's \& \gamma's$) the number of periods used to compute the average can vary depending on the country.

Shadow Economy Average shadow economy prevalence between 1999 and 2007. Taken from Hassan and Schneider (2016) they use indicators such as the use of cash, the growth of the economy and of the labor force, the tax burden the size of the government and other proxies to quantify the scope of the shadow economy in a country and build a dataset comparable across countries.

Skill Mismatch Index Calculate by IMF Staff. It takes the ILO estimations of shares of the employment by sector and shares of the population by education level. Given a set of skills, the index is a measure of the distance between the percent of the labor force with a given level of skills (skill level supply) and the proportion of employees with the same level of skills (skill level demand). Each country's labor force and sectors are divided into three categories (i) low-skilled (less than secondary education), (ii) semi-skilled (with secondary education), and (iii) high-skilled (with more than secondary education).[2] The index is given by the sum of the squared distances for the three skill levels for each country and over time:

$$SMI_{it} = \sum_{j=1}^{3} \left(\mathrm{S_{ijt}} - \mathrm{M}_{ijt}\right)^2$$

where j= skill level, S_{ijt}= percent of labor force with skill level j at time t in country i, and $\mathrm{M_{ijt}}$=percent of employees with skill level j and time t in country i.

Services as % of GDP Services correspond to ISIC divisions 50–99 and they include value added in wholesale and retail trade (including hotels and restaurants), transport, and government, financial, professional, and personal services such as education, health care, and real estate services. Also included are imputed bank service charges, import duties, and any statistical discrepancies noted by national compilers as well as discrepancies arising from rescaling. Value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs. It is calculated without making deductions for depreciation of fabricated assets or depletion and degradation of natural resources. The industrial origin of value added is determined by the International Standard Industrial Classification (ISIC), revision 3. Note: For VAB countries, gross value added at factor cost is used as the denominator.
Source: WDI.

Business Regulations This indicator is taken from the Fraser Institute below is the description contained in the methodological annex for each of its

[2] Low-skilled sectors are (i) mining and logging and (ii) construction; semi-skilled sectors are (i) manufacturing, (ii) trade, transportation and utilities, (iii) leisure and hospitality, (iv) other services; high-skilled sectors are (i) information, (ii) financial activities, (iii) education and health care, (iv) professional and business services, and (v) government.

subcomponents- that includes the original source and the scale. High values are associated with less regulations.

i) *Administrative requirements*

This sub-component is based on the *Global Competitiveness Report* question: "Complying with administrative requirements (permits, regulations, reporting) issued by the government in your country is (1 = burdensome, 7 = not burdensome)."
Source: World Economic Forum, *Global Competitiveness Report*.

ii) *Bureaucracy costs*

This sub-component is based on the *Global Competitiveness Report* question: "Standards on product/service quality, energy and other regulations (outside environmental regulations) in your country are: (1 = Lax or non-existent, 7 = among the world's most stringent)."
Source: World Economic Forum, *Global Competitiveness Report*.

iii) *Starting a business*

This sub-component is based on the World Bank's *Doing Business* data on the amount of time and money it takes to start a new limited liability business. Countries where it takes longer or is more costly to start a new business are given lower ratings. Zero-to-10 ratings were constructed for three different variables: (1) time (measured in days) necessary to comply with regulations when starting a limited liability company, (2) money costs of the fees paid to regulatory authorities (measured as a share of per-capita income) and (3) minimum capital requirements; that is, funds that must be deposited into a company bank account (measured as a share of per-capita income). These three ratings were then averaged to arrive at the final rating for this sub-component. The formula used to calculate the zero-to-10 ratings was: (Vmax − Vi) / (Vmax − Vmin) multiplied by 10. Vi represents the variable value. The values for Vmax and Vmin were set at 104 days, 317%, and 1017% (1.5 standard deviations above average in 2005) and 0 days, 0%, and 0%, respectively. Countries with values outside of the Vmax and Vmin range received ratings of either zero or 10 accordingly.
Source: World Bank, *Doing Business*.

iv) *Extra payments/bribes/favoritism*

This sub-component is based on the *Global Competitiveness Report* questions: [1] "In your industry, how commonly would you estimate that firms make undocumented extra payments or bribes connected with the following: A—Import and export permits; B—Connection to public utilities (e.g., telephone or electricity); C—Annual tax payments; D—Awarding of public contracts (investment projects); E—Getting favorable judicial decisions. Common (= 1) Never occur (= 7)." [2] "Do illegal payments aimed at influencing government policies, laws or regulations have an impact on companies in your country? 1 = Yes, significant negative impact, 7 = No, no impact at all." [3] "To what extent do government officials in your country show favoritism to well-connected

firms and individuals when deciding upon policies and contracts? 1 = Always show favoritism, 7 = Never show favoritism."

Source: World Economic Forum, *Global Competitiveness Report*.

Labor market regulations

This indicator is a combination of the following subcomponents.

i) Hiring market regulations

This sub-component is based on the World Bank's Doing Business "Difficulty of Hiring Index", which is described as follows: "The difficulty of hiring index measures (i) whether fixed-term contracts are prohibited for permanent tasks; (ii) the maximum cumulative duration of fixed term contracts; and (iii) the ratio of the minimum wage for a trainee or first-time employee to the average value added per worker. An economy is assigned a score of 1 if fixed-term contracts are prohibited for permanent tasks and a score of 0 if they can be used for any task. A score of 1 is assigned if the maximum cumulative duration of fixed-term contracts is less than 3 years; 0.5 if it is 3 years or more but less than 5 years; and 0 if fixed-term contracts can last 5 years or more. Finally, a score of 1 is assigned if the ratio of the minimum wage to the average value added per worker is 0.75 or more; 0.67 for a ratio of 0.50 or more but less than 0.75; 0.33 for a ratio of 0.25 or more but less than 0.50; and 0 for a ratio of less than 0.25." Countries with higher difficulty of hiring are given lower ratings.
Source: World Bank, Doing Business.

ii) Hiring and firing regulations

This sub-component is based on the Global Competitiveness Report question: "The hiring and firing of workers is impeded by regulations (= 1) or flexibly determined by employers (= 7)." The question's wording has varied over the years.
Source: World Economic Forum, Global Competitiveness Report.

iii) Centralized collective bargaining

This sub-component is based on the Global Competitiveness Report question: "Wages in your country are set by a centralized bargaining process (= 1) or up to each individual company (= 7)." The wording of the question has varied over the years.

Source: World Economic Forum, Global Competitiveness Report.

iv) Hours regulations

This sub-component is based on the World Bank's Doing Business "Rigidity of Hours Index", which is described as follows: "The rigidity of hours index has 5 components: (i) whether there are restrictions on night work; (ii) whether there are restrictions on weekly holiday work; (iii) whether the workweek can consist of 5.5 days; (iv) whether the workweek can extend to 50 hours or more (including overtime) for 2 months a year to respond to a seasonal increase in production; and (v) whether paid annual vacation is 21 working days or fewer. For questions (i) and (ii), when restrictions other than premiums apply, a score of 1 is given. If the only restriction is a premium for night

work and weekly holiday work, a score of 0, 0.33, 0.66 or 1 is given according to the quartile in which the economy's premium falls. If there are no restrictions, the economy receives a score of 0. For questions (iii), (iv) and (v), when the answer is no, a score of 1 is assigned; otherwise a score of 0 is assigned." Countries with less-rigid work rules receive better scores in this component.
Source: World Bank, Doing Business.

v) Mandated cost of worker dismissal

This sub-component is based on the World Bank's Doing Business data on the cost of the advance notice requirements, severance payments and penalties due when dismissing a redundant worker with 10 years tenure. The formula used to calculate the zero-to-10 ratings was: (Vmax − Vi) / (Vmax − Vmin) multiplied by 10. Vi represents the dismissal cost (measured in weeks of wages). The values for Vmax and Vmin were set at 58 weeks (1.5 standard deviations above average in 2005) and 0 weeks, respectively. Countries with values outside of the Vmax and Vmin range received ratings of either zero or 10 accordingly.
Source: World Bank, Doing Business.

vi) Conscription

Data on the use and duration of military conscription were used to construct rating intervals. Countries with longer conscription periods received lower ratings. A rating of 10 was assigned to countries without military conscription. When length of conscription was 6 months or less, countries were given a rating of 5. When length of conscription was more than 6 months but not more than 12 months, countries were rated at 3. When length of conscription was more than 12 months but not more than 18 months, countries were assigned a rating of 1. When conscription periods exceeded 18 months, countries were rated zero. If conscription was present, but apparently not strictly enforced or the length of service could not be determined, the country was given a rating of 3. In cases where it is clear conscription is never used, even though it may be possible, a rating of 10 is given. If a country's mandated national service includes clear non-military options, the country was given a rating of 5.
Source: International Institute for Strategic Studies, *The Military Balance*; War Resisters International, *World Survey of Conscription and Conscientious Objection to Military Service*; additional online sources used as necessary.

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