BRAZIL

SELECTED ISSUES

July 2017

This paper on Brazil was prepared by a staff team of the International Monetary Fund as background documentation for the periodic consultation with the member country. It is based on the information available at the time it was completed on June 20, 2017.

INTERNATIONAL MONETARY FUND

BRAZIL

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INVESTMENT IN BRAZIL: FROM CRISIS TO RECOVERY[1]

While Brazil's deep recession has been broad based, it has been marked by a particularly large fall in investment. Real investment fell by around 30 percent between the beginning of 2014 and the beginning of 2017. This chapter finds that a variety of factors contributed to the investment decline, including a deterioration in Brazil's medium-term growth prospects, rising real interest rates, falling terms of trade, rising uncertainty related to economic policy, rising levels of corporate leverage and lower cash flow. Some of the factors that have weighed on investment over recent years have begun to normalize providing some impetus for a recovery. However, still-high levels of corporate leverage and the prospect of continued uncertainty related to economic policy settings suggest a turnaround in investment is likely to be subdued.

A.   Introduction

1.   Brazil's deep recession has been broad based with a particularly large fall in investment. Real investment recovered strongly following the global financial crisis amid rising terms of trade, low interest rates, rapidly expanding consumption, and widespread optimism about Brazilian growth prospects. However, the expansion proved short lived as the favorable factors that supported the recovery began to wane and economic and policy uncertainty began to rise. Since the beginning of 2014, real investment has contracted by around 30 percent, far weaker investment than most other emerging markets experienced over this time.

2.   Some of the factors that are hampering investment might soon support a recovery, but other factors—such as high levels of corporate leverage and policy uncertainty—suggest the recovery might be more prolonged (Figure 1). The central bank has begun an easing cycle and real interest rates are expected to fall significantly over the coming year, and, after trending down for several years, Brazil's terms of trade stabilized and improved in early 2016. By reducing funding costs and increasing profitability, both factors should help to support a recovery in investment. However, these developments come against the backdrop of a prolonged recession that has damaged Brazil's long-term

Brazil: National Accounts Components
(Index, 2010Q1 = 100)
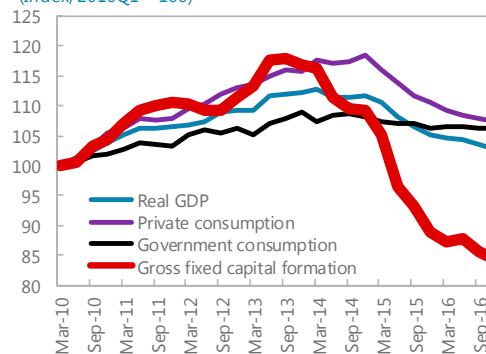
Source: Haver Analytics.

Brazil and EMs: Real Gross Fixed Capital Formation
(Index, 2000 = 100)
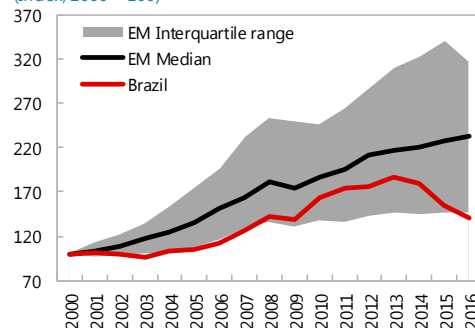
Source: World Economic Outlook.

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[1] Prepared by Ivo Krznar (MCM) and Troy Matheson (WHD).

growth prospects and led to higher levels of corporate leverage; prospects of weaker growth in the future hurts expected returns and discourages investment while higher leverage reduces the demand and supply of investment funding. Moreover, following a dramatic deterioration in the fiscal position and the impeachment of President Rousseff, the government has embarked on an ambitious fiscal reform agenda that is subject to implementation challenges, contributing to heightened policy uncertainty that could weigh on firms' willingness invest.

Figure 1. Brazil: Gross Fixed Capital Formation and Other Key Variables

Source: Staff estimates and Haver Analytics.
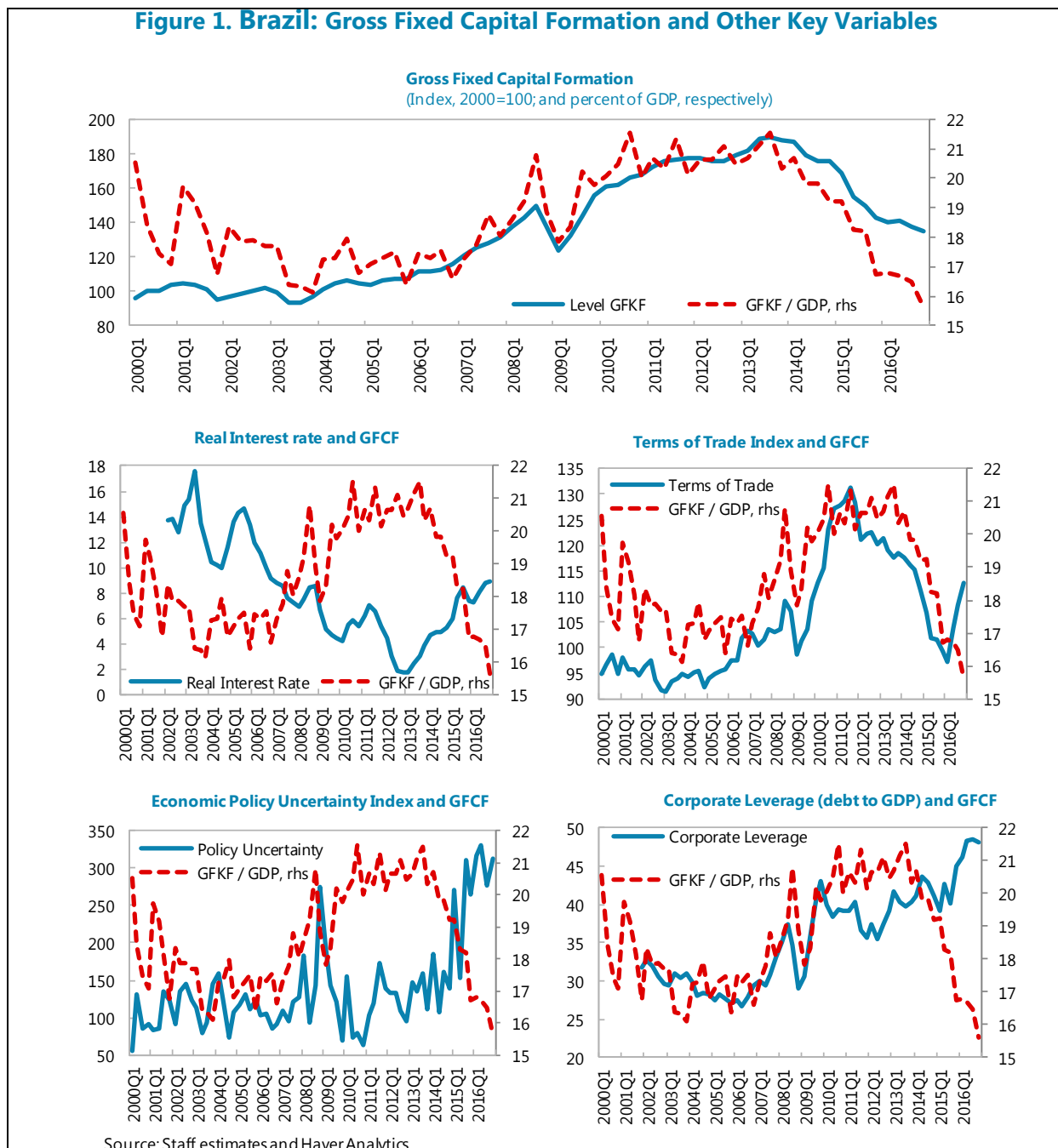
3.   **This chapter examines the proximate causes of dramatic fall in investment in Brazil and the prospects for investment going forward.** Section B provides an analysis and discussion of Brazil's investment using aggregate data. Firm-level data are examined and discussed in Section C. The chapter concludes with a discussion of the prospects for a recovery in investment.

B.   Aggregate Empirical Analysis

4.   **Medium-term growth and investment are linked.** Current levels of investment increase the economy's capital stock and enhance future labor productivity and growth. At the same time, firms' expectations of medium-term growth help to determine expected returns to investment and investment levels themselves. As such, the empirical specification is chosen to allow for feedback effects from growth expectations and investment and for the impact of other variables that influence investment decisions, including input costs (regulated prices and unit labor costs), funding costs (the real interest rate), profitability (terms of trade), leverage, and economic policy uncertainty.[2]

5.   **Two equations are jointly estimated to describe the behavior of quarterly real investment growth.** The first equation determines the part of medium-term growth expectations (3-years-ahead) that cannot be explained by current economic conditions and the second equation determines real investment growth. Medium-term growth expectations (3-years-ahead) Z_t are assumed to be determined by annual real GDP (y_t) growth, annual regulated-price (p_t) inflation, annual changes in the terms of trade (t_t) and the real interest rate (r_t), and annual growth in equity prices (s_t) and unit labor costs (l_t) (see table for data sources and definitions):[3]

Data, Sources and Transforms

Label	Variable	Source	Units
Z_t	Real GDP Growth Expectations (3-years ahead)	BCB	Level, %
i_t	Real Gross Fixed Capital Formation	IBGE	Level, log
y_t	Real GDP	IBGE	Level, log
p_t	Regulated Prices, IPCA	IBGE	Level, log
t_t	Term of Trade	Haver	Level, log
r_t	Real Interest Rate (Selic - 12-month-ahead inflation expectations)	BCB	Level, log
s_t	Equity Price Index	Haver	Level, log
l_t	Unit Labor Costs, $R	BCB	Level, log
L_t	Corporate Leverage (corporate debt to GDP)	IMF	Level, %GDP
U_t	Economic Policy Uncertainty	Haver	Level, log

$$Z_t = \alpha_1 \Delta^4 y_t + \alpha_2 \Delta^4 p_t + \alpha_3 \Delta^4 t_t + \alpha_4 \Delta^4 r_t + \alpha_5 \Delta^4 s_t + \alpha_6 \Delta^4 l_t + \epsilon_t^Z \tag{1}$$

where Δ^4 represents the annual change in each variable and ϵ_t^Z is the part of medium-term growth expectations that represents other factors unrelated to current economic conditions. These factors represent an *autonomous* reassessment of medium-term growth, above and beyond the impact of contemporaneous (short term) economic developments. Quarterly investment growth is assumed to be driven by the same variables as growth expectations, in addition to the estimated residual from

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[2] Economic policy uncertainty is measured using the Economic Policy Uncertainty (EPU) Index for Brazil in the same manner as the newspaper-based EPU Index for the United States, following the methods in "Measuring Economic Policy Uncertainty" by Baker, Bloom and Davis (see policyuncertainty.com and Appendix I, Section A for more details).

[3] The estimates of medium-term growth expectations are described in Appendix I, Section B.

equation (1) and lags of corporate leverage (measured as total corporate debt over GDP) L_t and an index of economic policy uncertainty U_t:[4]

$$\Delta i_t = \beta_1 \Delta p_{t-1} + \beta_2 \Delta t_t + \beta_2 \Delta r_{t-1} + \beta_3 \Delta s_{t-1} + \beta_4 \Delta l_{t-1} + \beta_5 \epsilon_{t-1}^Z + + \sum_{i=1}^{4} \beta_i^L L_{t-i} + \sum_{i=1}^{4} \beta_i^U U_{t-i} + \epsilon_t^{\Delta i} \quad (2)$$

where Δ represents the quarterly change in each variable.

6.   The estimated model provides a good description of behavior of investment over history. Three different variants of the model are estimated using Seemingly Unrelated Regressions (the estimation results are displayed in Appendix I, Section B). The preferred model specification (model 3) fits quarterly investment growth very well considering the volatility of the series (the adjusted R-squared statistic is around 0.7). Moreover, the signs of the coefficients in the investment equation are intuitive. Specifically, the estimated parameters suggest:

- *Investment increases* with higher autonomous growth expectations for the future and higher terms of trade;

- *Investment decreases* with higher real interest rates, unit labor costs, regulated prices, leverage, and policy uncertainty.

7.   What explains the rapid drop in investment since 2014? Estimates suggest that developments hampering investment over this period include a rise in costs (chiefly a sharp increase in regulated prices, such as energy prices, but also unit labor costs), falling terms of trade—impacting prospects for commodity exporters—and higher interest rates (Figure 2). The "autonomous" part of the deterioration in the medium-term outlook for growth and heightened policy uncertainty have been the most significant drags on investment over this time, with each factor reducing investment by around 10 percent since beginning of 2014. Higher leverage contributed to fall in investment primarily during the period when it was rising fast (2015).

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[4] Note, variants of the model that include leverage and policy uncertainty in equation 1 were also estimated but leverage and policy uncertainty were not found to be statistically significant.

Figure 2. Brazil: Decomposition of Gross Fixed Capital Formation Growth

(Quarter-on-quarter growth accumulated since 2014Q1, deviations from avg, all variables demeaned)

Source: IMF staff estimates.
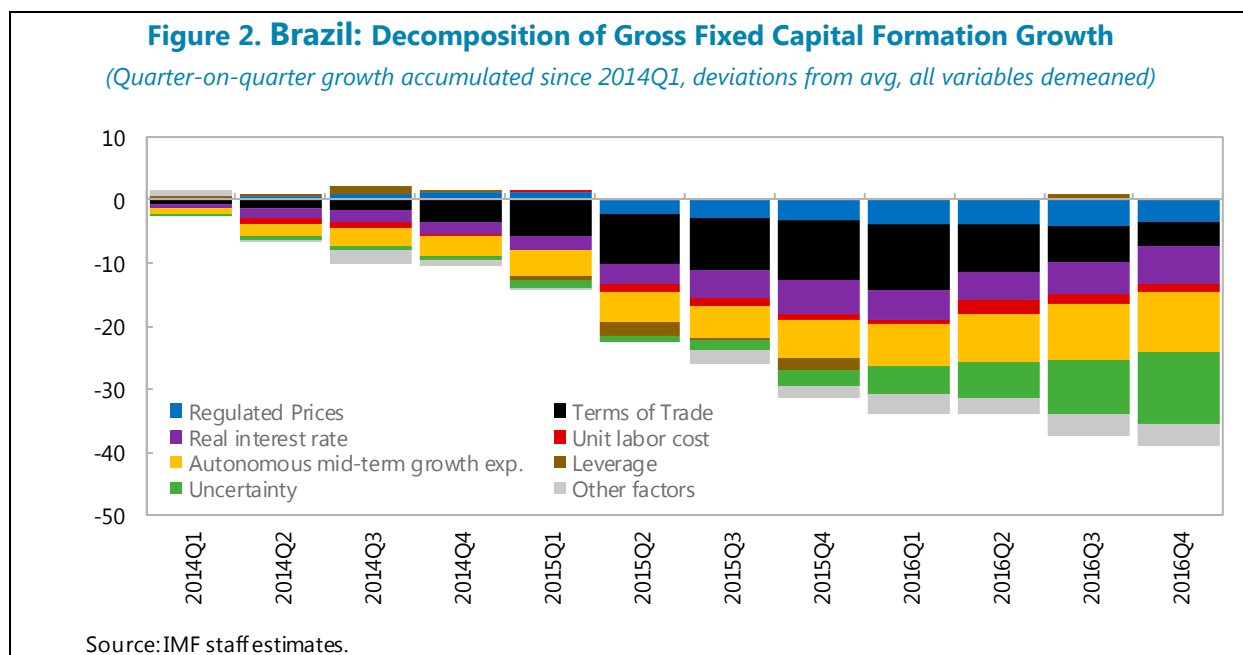
C. A Closer Look at Investment at the Firm Level

8.   As in Magud and Sosa (2015) and Li and others (2015), a panel regression model that relates each firm's investment-to-capital ratio to several determinants of firms' investment decisions was estimated to study factors driving investment at the individual firm level. The macroeconomic determinants of investment studied in the previous section are assumed to affect investment via firms' balance sheets. The model differentiates between *fundamental* factors that drive investment decisions (factors that capture the marginal productivity of capital) and *financial* factors that can also affect investment (factors that capture financing constraints). The investment-to-capital ratio is assumed to be driven by:

Fundamentals:

- The change in sales to proxy for demand and expected future growth (as in the standard accelerator model of investment);

- Tobin's Q to capture the expected marginal return on investment.

Financial Factors:

- Leverage, cash flow, the change in debt, and debt repayment capacity.

The only other control variable included is a measure of political uncertainty; this variable is less likely to be endogenous to the firm-level variables than other macroeconomic variables such as interest rates, GDP, and the terms of trade.[5]

9.   Leverage, cash flow, and changes in debt capture the relevance of each firm's financial structure for access to investment finance. High leverage may constrain firms' ability to obtain external financing for new investment; high leverage provides less investment incentives to controlling shareholders as a larger share of the gains will necessarily accrue to debtholders. Cash flow is commonly used in investment models as an indicator for internally available funds (see Hubbard, 1998) and the severity of financial constraints—tighter financial constraints increase reliance on internal funding for investment. While higher leverage is expected to be negatively associated with investment, the flow of debt is expected to be positively related to capital expenditures because financing investment is one of the main reasons to incur new debt. Tighter debt repayment capacity, on the other hand, is expected to be associated with lower investment.

10.   The baseline model specification is:

$$\frac{I_{it}}{K_{it-1}} = \beta LEV_{it-1} + \gamma \frac{CF_{it}}{K_{it-1}} + \delta \frac{\Delta DEBT_{it}}{K_{it-1}} + \theta \frac{\Delta SALES_{it}}{K_{it-1}} + \rho TOBIN\_Q_{it} + \xi ICR_{it} + \varpi UNCER_t + \lambda_t + \nu_i + \varepsilon_{it}$$

where I_{it} is firm i's net investment in period $\underline{t}$, K_{it-1} its capital stock at the beginning of the period, LEV_{it} is the firm's leverage, $\Delta DEBT_{it}$ is its change in total debt, $\Delta SALES_{it}$ is the change total sales, $TOBIN\_Q_{it}$ its average Tobin's Q (a proxy for unobservable marginal Q), ICR_{it} is a measure of the firm's interest coverage ratio (a proxy for debt repayment capacity), and $UNCER_t$ is the index of political uncertainty used in the previous section.[6,7] To control for unobserved heterogeneity across firms, and other aggregate effects not explicitly modeled here, the model is estimated with firm-specific (ν_i) and time effects (λ_t); firm-specific effects control for systematic differences in the average investment rate across firms and time effects control for a common investment component reflecting other macroeconomic factors that can influence firm-level investment. The final term in the equation is the idiosyncratic error, ε_{it}.[8]

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[5] For example, expected GDP growth rate will be reflected in Tobin's Q, terms of trade will affect cash flow, Tobin's Q, sales; interest rates will affect cash flow and the interest coverage ratio. Specifications were examined that included a real interest rate and a nominal interest rate, but the associated coefficients were insignificant.

[6] The empirical investment literature shows that lagged investment rate might be an important determinant of current investment spending (Gilchrist and Himmelberg, 1995; Eberly and others, 2012). In the case of Brazil, including lagged investment ratio as an explanatory variable did not significantly change the estimation results.

[7] Different interaction terms were also explored such as between leverage and firm size (smaller firms tend to be more dependent on bank financing and have lower spare capacities and a lower ability to access alternative financing options leverage and uncertainty(firms with relatively higher leverage reduce investment more aggressively in response to higher uncertainty shock), cash flow and uncertainty (higher uncertainty could increase or decrease the marginal propensity to invest out of cash flows). None of these interaction terms were significant probably due to multicollinearity issues.

[8] Leverage enters the equation with a lag whereas, cash flow, debt growth and the interest coverage ratio contemporaneously, as in Magud and Sosa (2015) and Li and others (2015).

11.   Data from firm-level balance sheets and income statements are sourced from Capital IQ. The sample covers over 4,000 Brazilian firms spanning 1995 to 2016.[9] To adjust for outliers, all firm-specific ratios are winsorized using 1st and 99th percentiles and some additional constraints are imposed.[10] The definition of each variable is provided in Table 1.

Table 1. Brazil: Variable Definitions		
Variable	**Definition**	**Robustness check**
Investment ratio	Capital expenditure within the year over the capital stock at the beginning of the year (net property, plant and equipment+depreciation and amortization-investment within the year)	
Leverage ratio	Total debt net of cash+cash equivalents over total assets-cash and cash equivalents	Total debt net of cash and cash equivalents over total common equity or EBITDA
Cash flow ratio	Net income+depreciation over the capital stock at the beginning of the year	EBIT over the capital stock at the beginning of the year
Change in debt ratio	Change in total debt over over the capital stock at the beginning of the year	
Change in sales ratio	Change in revenues over the capital stock at the beginning of the year	
Tobin's Q	Market capitalization-total equity+total assets over total assets	Price to book ratio
Interest coverage ratio	EBITDA over interest expense	
Uncertainty	Change in Economic Policy Uncertainty by Scott Baker, Nicholas Bloom and Steven J. Davis	
Source: IMF staff estimates.		

12.   Estimation results of the baseline model are consistent with the findings of the analysis at the aggregate level. Table 2 shows the estimated parameters (and their statistical significance) for 7 variations of the model, ranging from a simple model that relates investment to leverage only to the full model specification described above. Robustness checks, including models using the alternative variable definitions displayed in Table 2, are displayed in Appendix I, Section C. The results can be summarized as follows:

- *Investment increases* with higher expected future profitability (proxied by Tobin's Q and sales growth), cash flows, and debt flows, as expected;

- *Investment decreases* with higher leverage and higher political uncertainty. For example, a 10 percentage point rise in a large firm's leverage is associated with a 1.1–1.4 percentage point fall in the investment-to-capital ratio. This suggests that financial constraints and political uncertainty play an important role in investment decisions and could help to explain the recent large drop in investment at the aggregate level.

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[9] While this is potentially a large sample, the data is sparse and concentrated in the period from 2010 to 2016.

[10] The cutoff values are 250 and -50 for investment to capital ratios, 20 and -20 for sales growth ratios and debt growth ratios, 10 and -10 for cash flow ratios, 50 and 0 for Tobin's Q and 100 and 0 for leverage ratios.

Table 2. Brazil: Regression Results, All Sectors

Dependent variable: Investment to capital ratio

Explanatory variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Leverage, lag	-0.116 ***	-0.120 ***	-0.115 ***	-0.110 ***	-0.139 ***	-0.116 ***	-0.112 ***
	(0.022)	(0.023)	(0.028)	(0.021)	(0.019)	(0.022)	(0.021)
Cash Flow ratio		0.031 ***	0.029 ***	0.022 ***	0.034 **	0.049 ***	0.049 ***
		(0.005)	(0.005)	(0.005)	(0.015)	(0.015)	(0.015)
Change in debt ratio			0.016 ***	0.011 ***	0.007	0.008	0.008 *
			(0.002)	(0.003)	(0.005)	(0.005)	(0.005)
Change in sales ratio				0.010 ***	0.006	0.003	0.003
				(0.003)	(0.006)	(0.007)	(0.007)
Tobin's Q					0.005 ***	0.005 ***	0.004 ***
					(0.002)	(0.002)	(0.002)
Interest coverage ratio						0.001	0.001
						(0.001)	(0.001)
Uncertainty, diff, lag							-0.001 **
							(0.000)
Number of observations	10,763	10,378	10,144	9,805	2,392	2,311	2303
Number of firms	3,286	3,151	3,052	2,930	297	291	291
R^2	0.01	0.03	0.03	0.03	0.04	0.05	0.05

Source: Author's calculations
Note: ***, **, * indicate significance at the 1 percent, 5 percent, and 10 percent levels, respectively.
Standard errors in parentheses are Driscoll and Kraay (1998) robust to heteroscedasticity, autorcorrelation with MA(q), and cross-sectional dependency. The estimation period is 1995–2016. Firm-level fixed effects and time effects are included.

13.   Higher leverage and policy uncertainty are negatively correlated with investment across most sectors of the economy. Table 3 displays results from models estimated using firms from eight different sectors of the economy. Leverage is statistically significant across most sectors, with health and real estate sectors being the only exceptions. The impact of leverage on investment is particularly large in the energy sector, possibly reflecting the relatively high levels of leverage and falling investment levels at the state-owned energy producer, Petrobras. At the same time, policy uncertainty appears to have significant effects on investment levels in the healthcare, industrials, real estate, and utility sectors, possibly due to a higher aversion to risks associated macroeconomic policy settings among these industries.

D.   Summary and Conclusion

14.   There are several factors that have contributed to the decline in investment since 2014. Rising costs, falling profitability—and expected profitability—and higher levels of corporate leverage appear to have played a role in the decline in investment over the course of the recession. The empirical evidence in this chapter also suggests that a rise in policy uncertainty has played a significant role in the decline.

Table 3. Brazil: Regression Results, by Sector

Dependent variable: Investment to capital ratio

Explanatory variable	Consumer Discretionary	Consumer Staples	Energy	Healthcare	Industrials	Real Estate	Telecomm-unication	Utilities
Leverage, lag	-0.142 ***	-0.230 ***	-0.336 ***	0.072	-0.119 ***	-0.062	-0.369 ***	-0.182 ***
	(0.047)	(0.033)	(0.069)	(0.120)	(0.036)	(0.042)	(0.135)	(0.050)
Cash Flow ratio	-0.016	0.069 ***	0.094 ***	-0.056	0.029 *	0.039 *	0.099 ***	-0.001
	(0.017)	(0.020)	(0.025)	(0.043)	(0.018)	(0.022)	(0.035)	(0.010)
Change in debt ratio	0.002	-0.001	0.044 **	-0.002	0.019 ***	0.001	0.101 ***	-0.003
	(0.004)	(0.006)	(0.022)	(0.015)	(0.006)	(0.005)	(0.038)	(0.004)
Change in sales ratio	0.017 ***	0.007 **	-0.019 **	-0.005	0.007 **	0.008	-0.025	0.016 ***
	(0.007)	(0.003)	(0.007)	(0.014)	(0.007)	(0.005)	(0.019)	(0.003)
Uncertainty, diff, lag	-0.000	-0.000	-0.000	-0.001 ***	-0.000 ***	-0.001 ***	-0.001	-0.000 ***
	(0.000)	(0.000)	(0.000)	(0.008)	(0.000)	(0.000)	(0.001)	(0.000)
Number of observatio	1,082	970	282	329	2,160	1,133	137	1215
Number of firms	357	272	80	128	677	422	28	359
R^2	0.05	0.08	0.21	0.06	0.06	0.04	0.29	0.06

Source: Author's calculations
Note: ***, **, * indicate significance at the 1 percent, 5 percent, and 10 percent levels, respectively.
Standard errors in parentheses are Driscoll and Kraay (1998) robust to heteroscedasticity, autorrelation with MA(q),
and cross-sectional dependency. The estimation period is 1995–2016. Firm-level fixed effects and time effects are included.

15.   Some factors point to stronger investment in the short term. The empirical results suggest that stabilization of regulated-price inflation, the terms of trade, and real interest rates should improve both investment growth and growth expectations. The large and necessary increases in fuel and electricity tariffs in 2015 and are not expected to be repeated going forward, the central bank has begun an easing cycle that is expected to continue over the remainder of 2017, and Brazil's terms of trade have improved markedly since the beginning of 2016. These are positive signs.

16.   However, headwinds remain. While stabilization of some of the factors weighing on investment should provide some support investment in the short term, the prospect of a return to past levels of strong investment growth crucially depends on an alleviation of other sources of weakness, most notably high levels of corporate leverage and policy uncertainty and low medium-term growth expectations. While corporate leverage appears to have stabilized recently, it remains high from both a historical perspective and relative to other countries in the region. The analysis also suggests that if medium-term growth expectations remain subdued, the recovery in investment may be incomplete. Likewise, implementation challenges related the governments reform agenda—most notably related to pension reform—and the prospect of rising levels of government debt over the next several years could lead to persistently high policy uncertainty that might weigh on investment decisions for some time.

Appendix I. Data, Results, and Robustness

A. Economic Policy Uncertainty

The Economic Policy Uncertainty (EPU) Index for Brazil is computed in the same manner as the newspaper-based EPU Index for the United States, following the methods in "Measuring Economic Policy Uncertainty" by Baker, Bloom and Davis (policyuncertainty.com).

- The index is derived from the text archives of the newspaper Folha de São Paulo from 1991 onwards. The raw data for the index is the number articles containing relevant terms. Specifically, the number of articles containing the terms "incerto" or "incerteza", "econômico" or "economia", and one or more of the following policy-relevant terms: regulação, déficit, orçamento, imposto, banco central, alvorada, planalto, congresso, senado, câmara dos deputados, legislação, lei, tarifa.

- To obtain the EPU rate, the raw EPU counts are scaled by the number of all articles in the same newspaper and month. The resulting series is multiplicatively rescaled to a mean of 100 from January 1991 to December 2011.

B. Estimating Medium-Term Growth Expectations

The Brazilian central bank has a very comprehensive consensus expectations survey. On a weekly basis, forecasters submit their expectation for end-of-year Real GDP growth for the current year, as well as for the 4 years ahead. The Central Bank then reports averages, medians, and other properties of the sample in their website.

While there is no constant forecast horizon, forecasts usually behave in a predictable fashion (see Figure below). The surveyors ask analysts for end-of-year forecasts, which means that, for any given year, the forecast horizon shortens as time passes. However, since the underlying models expect the economy to return to potential GDP growth over the long run, there is a strong relationship between expected growth and forecast horizons.

This exercise builds on this relationship. The starting point to estimate a continuous time-series for mid-term growth expectations, then, regresses forecasts on a polynomial of the forecast horizon:

$$E_t\left[\Delta g_{t+s}^{yoy}\right] = c_t + \gamma_t (s-t)_{t,s} + \phi_t (s-t)_{t,s}^2 + e_t \qquad (1)$$

where $E_t\big[\Delta g_{t+s}^{yoy}\big]$ is end-of-year growth forecast for date s at time t; $(s-t)_{t,s}$ denotes the forecast horizon in days, c_t, γ_t and ϕ_t are time varying parameters estimated for each period t. Those parameters yield a continuous time series for growth expectations for any horizon h ahead:

$$\hat{E}_t\big[\Delta g_{t+s}^{yoy}\big] = \hat{c}_t + \hat{\gamma}_t(h) \ + \hat{\phi}_t(h)^2 \tag{2}$$

Brazil: Consensus GDP Growth Forecasts
(X-axis: forecast horizon, in years ahead; Y-axis: Yearly GDP Growth median forecast)

Source: Central Bank of Brazil.
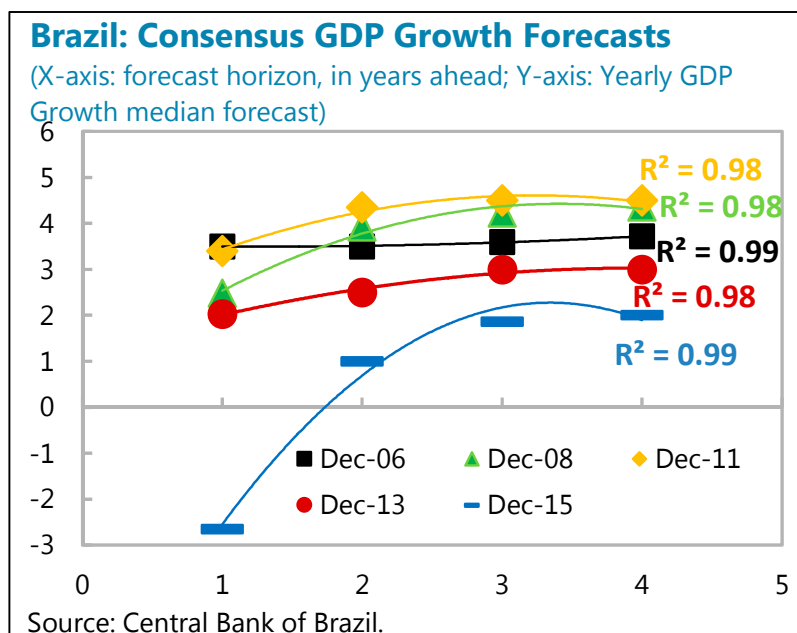
C. Estimation Results: Aggregate Model

Table 1. Brazil: Results—Aggregate Model			
Model			
	(1)	(2)	(3)
Growth Expectations			
$\Delta^4 y_t$	0.069**	0.093***	0.093***
	(0.026)	(0.027)	(0.027)
$\Delta^4 p_t$	-0.022	-0.031	
	(0.019)	(0.020)	
$\Delta^4 t_t$	0.030**	0.028*	0.029**
	(0.014)	(0.014)	(0.014)
$\Delta^4 r_t$	-0.094***	-0.105***	-0.106***
	(0.035)	(0.033)	(0.032)
$\Delta^4 s_t$	-0.006	-0.009**	-0.010***
	(0.004)	(0.004)	(0.004)
$\Delta^4 l_t$	0.013	0.011	
	(0.015)	(0.015)	
R-Squared	0.507	0.499	0.496
Adjusted R-Squared	0.458	0.439	0.467
Investment Growth			
Δp_{t-1}	-0.793***	-0.512***	-0.542***
	(0.187)	(0.167)	(0.165)
Δt_t	0.411***	0.448***	0.476***
	(0.108)	(0.100)	(0.092)
Δr_{t-1}	-0.009***	-0.009***	-0.009***
	(0.003)	(0.002)	(0.002)
Δs_{t-1}	0.096***	0.041	
	(0.029)	(0.028)	
Δl_{t-1}	-0.104	-0.167**	-0.173***
	(0.068)	(0.064)	(0.059)
ϵ_{t-1}^Z	1.360**	1.110**	1.179**
	(0.536)	(0.479)	(0.483)
L_{t-1}		0.520***	0.529***
		(0.136)	(0.130)
L_{t-2}		-0.381*	-0.581***
		(0.206)	(0.131)
L_{t-3}		-0.282	
		(0.212)	
L_{t-4}		0.080	
		(0.143)	
U_{t-1}		0.143	
		(0.986)	
U_{t-2}		0.201	
		(1.047)	
U_{t-3}		-1.976*	-1.370*
		(1.039)	(0.821)
U_{t-4}		-2.067**	-2.181**
		(0.951)	(0.877)
R-Squared	0.696	0.790	0.770
Adjusted R-Squared	0.635	0.698	0.704
Jointly estimated standard errors in parentheses. * p < 0.1, ** p < 0.05, *** p < 0.01			

D. Robustness Checks: Firm-Level Model

Table 2. Brazil: Results—Firm-Level Model, Robustness Checks

Dependent variable: Investment to capital ratio

Explanatory variables	(4) with leverage (net debt/equity)	(4) with leverage (net debt/EBITDA)	(4) with cash ratio	(5) with Tobin Q	(7) estimated using GMM
Leverage, lag	-0.003 ***	-0.001 **	-0.110 ***	-0.292 ***	-0.172 ***
	(0.001)	(0.000)	(0.021)	(0.046)	(0.068)
Cash Flow ratio	0.028 ***	0.034 ***	0.021 **	0.025	0.049 ***
	(0.007)	(0.005)	(0.005)	(0.016)	(0.014)
Change in debt ratio	0.014 ***	0.015 ***	0.009 ***	0.009 **	0.008
	(0.003)	(0.002)	(0.002)	(0.005)	(0.007)
Change in sales ratio	0.008 ***	0.011 ***	0.009 ***	0.006	0.005
	(0.003)	(0.003)	(0.002)	(0.006)	(0.008)
Tobin's Q				0.004 ***	0.005 ***
				(0.001)	(0.004)
Interest coverage ratio					0.001
					(0.001)
Uncertainty, diff, lag					0.000 **
					(0.000)
Number of observations	9,144	11,391	9,779	2,632	2,190
Number of firms	2,833	3,357	2,925	382	290
R^2	0.03	0.04	0.03	0.06	-

Source: Author's calculations
Note: ***, **, * indicate significance at the 1 percent, 5 percent, and 10 percent levels, respectively.
Standard errors in parentheses are Driscoll and Kraay (1998) robust to heteroscedasticity, autorcorrelation with MA(q),
and cross-sectional dependency. The estimation period is 1995–2016. Firm-level fixed effects and time effects are included.

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BRAZIL'S BUSINESS ENVIRONMENT AND EXTERNAL COMPETITIVENESS[1]

This chapter provides an overview of competitiveness challenges in Brazil and identifies policies to improve competitiveness; it documents the impact of reforms on competitiveness using the parameters from existing empirical and quantitative studies, and reports on priority areas in need of reform flagged by the World Bank's Ease of Doing Business (DB) assessment. The analysis underscores the importance of reducing tariffs as well as non-tariff barriers. Lower tariffs on capital goods, greater integration into global value chains, more flexible labor, product and financial markets, and lighter procedures to pay taxes and obtain business permits are important for improving the external competitiveness.

A.   Ease of Doing Business

1.   Brazil's position in the World Bank DB ranking is disappointing, but has improved marginally since 2010. In 2017, Brazil ranked 123rd in a total of 190 states on which data were collected. Brazil's 2017 ranking is better compared to 2010, when it occupied rank 129 in a sample of 183 countries. However, Brazil's ranking fell slightly compared to its position in the previous survey as the country failed to keep up with reforms in the rest of the world. Between 2015 and 2016, 137 economies worldwide implemented 283 business regulatory reforms. This represents an increase of more than 20 percent compared to the previous year (Doing Business report, 2017).[2]

2.   Brazil shows weaknesses across several categories of Ease of Doing Business indicators. The procedures to start a business, obtain construction permits, pay taxes, and trade across borders, are uncommonly cumbersome. Slow progress on these issues over time has put Brazil below its peers in terms of business' attractiveness relative to countries that have meanwhile implemented reforms in many areas. Brazil does better in comparisons related to getting electricity, enforcing contracts, resolving insolvency and protecting minority rights.

Brazil: Doing Business Indicators, 2017
(Ranking)

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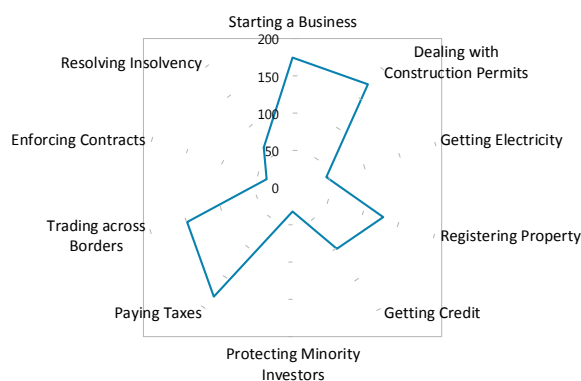
[1] Prepared by Izabela Karpowicz (WHD) and Kenji Moriyama (SPR).

[2] In 2016, 137 economies worldwide implemented 283 business regulatory reforms. This represents an increase of more than 20 percent compared to the previous year (Doing Business report, 2017).

3. **Looking across subcomponents of the overall score,** Brazil's global business

attractiveness improved in some areas but is overall weaker than the LAC average. To facilitate comparison across time, made difficult by changes in methodologies[3], the DB database includes a measure called "distance to frontier" (DTF) which measures performance as the deviation of a country from the best performer. The DTF score ranges from 0 to 100, with 0 representing the worst performer and 100 the frontier.[4] Brazil's DTF has been overall stable, with some improvement in recent years, notably in the areas of insolvency procedures, contract enforcement, and minority investor protection. Starting a business is also easier

Brazil: Doing Business Rankings
(Index from 0 to 100, where 0=lowest, 100=best)

Sources: Doing Business, The World Bank.

now, albeit still more complicated than elsewhere in the region. In a few areas, such as trading across borders, Brazil moved away from the frontier. In terms of the overall business environment, the largest five countries in the region (excluding Brazil), the LA5, are much closer to the frontier than Brazil.

Brazil: Changing Distance to Frontier, 2010-17 Comparison

	2017			2010-2017	
	Rank	DF	Below Latam	Worsening	Improvement
Overall	123	56.5	x		x
Starting a business	175	65.0			x
Resolving insolvency	67	49.2			
Dealing with construction permits	172	51.3	x		
Paying taxes	181	33.0	x	x	
Trading across borders	149	55.6	x	x	
Getting electricity	47	81.2		x	
Registering property	128	52.6		x	
Enforcing contracts	37	67.4			x
Protecting minority investors	32	65.0			x
Getting credit	101	45.0			

Source: Doing Business, The World Bank.

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[3] Methodological changes have been introduced most recently in 2011, 2014 and 2015 to expand coverage by introducing new indicators and revising the components and methodologies of existing indicators.

[4] The DTF score is calculated in two steps. First, DTF is calculated for each individual indicator using the formula: DTF for country j, indicator k= (Worst Performance – Country j's score on indicator k)/(Worst Performance—Best Performance). Second, the DTF scores for each individual indicator are consolidated through simple averaging into one DTF score for each of the ten topics, which ultimately provides a country's ranking on the topic. The country's overall ranking is a simple average of its rank across all ten topics.

Brazil: Ease of Doing Business–Distance to Frontier
(Index, 0-100, higher is better)

Sources: Doing Business, The World Bank.
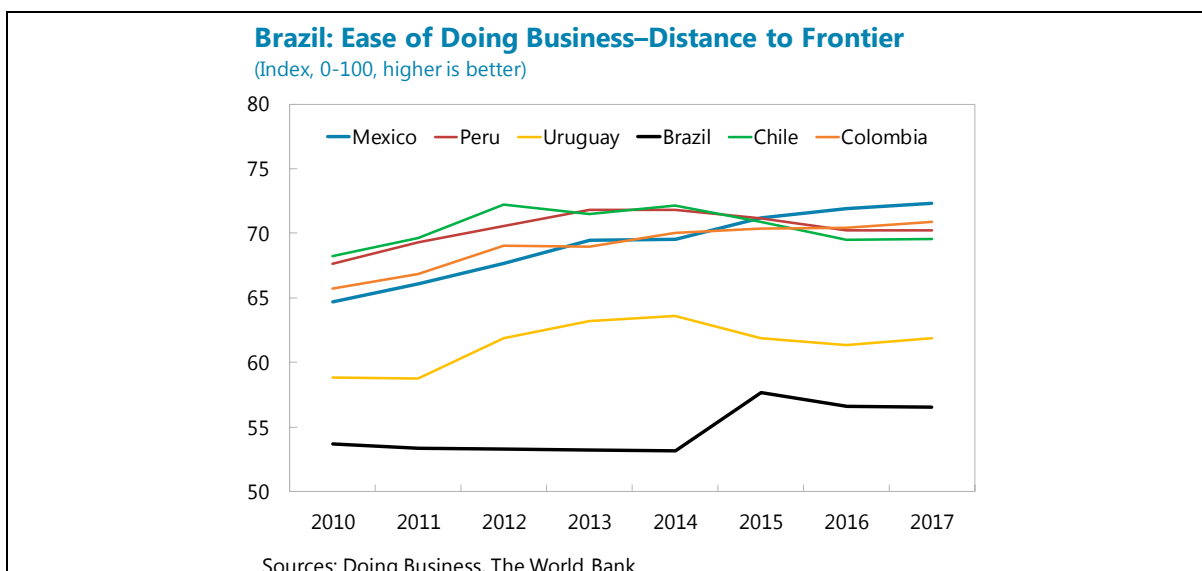
4.   Ease of doing business in Brazil is low relative to Brazil's income. Plotted against per capita GDP in 2015, Brazil's DTF appears too low (Brazil's index would have to move from the current 56 to 65 percent to approach the fitted line. Such an improvement would be difficult to achieve over a short period. In the latest DB, Kazakhstan was among the countries that increased the most its DTF in one year owing to reforms across seven dimensions of the index; still, the improvement was less than 5 percentage points.

5.   What makes Brazil's position weak?

- **Starting a business** is a cumbersome process in Brazil. An estimated 11 procedures (down from 14 in 2010) and about 80 hours are necessary to start a business. Although some improvement was achieved over the years in this dimension, Brazil scores relatively low compared to the average in Latin America.

Brazil: Doing Business and Per Capita GDP
(In logs)

Sources: DOB, WDI; and IMF staff estimates.

- **Paying taxes.** It takes 2038 hours a year for a firm to pay taxes in Brazil, an absolute maximum in the sample. This number fell from 2600 in 2010, a large improvement, but still insufficient considering this is double the time it takes to pay taxes in the second less efficient country according to this measure in Latin America, Bolivia. The reduction compliance time in Brazil was the result of electronic systems that were introduced some years ago resulting in more efficient tax compliance processes. However, although the time to pay taxes fell, the share of total taxes and contributions in pre-tax profits increased and it is estimated at slightly
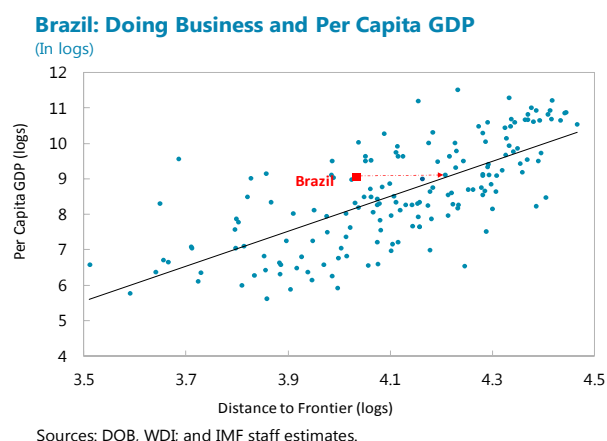
below 70 percent. The incidence of taxes in profits is only 30 percent in Chile, for instance.[5] OECD (2015) points to the fragmented and inefficient indirect tax system as one of the important contributors to the "Brazil cost." Tax credits for intermediate inputs are allowed only when they are embodied in the final good sold. The burden of proof regarding how much of an input goes directly into the final products lies with taxpayers, resulting in extensive use of tax accountants and frequent lawsuits over disputes.

- **Tax rates and tax regulations,** alongside corruption and inefficient bureaucracy, have been identified as the most problematic factors for doing business in Brazil in the 2015 World Economic Forum's survey.[6]

- Among its *political risk* index components, the International Country Risk Guide (ICRG) shows a low score—2 out of 6—on *corruption* (indicating high level of "potential corruption in the form of excessive patronage, nepotism, job reservations,

Brazil: Most Problematic Factors for Doing Business (2015)

Source: World Economic Forum's Executive Opinion Survey.
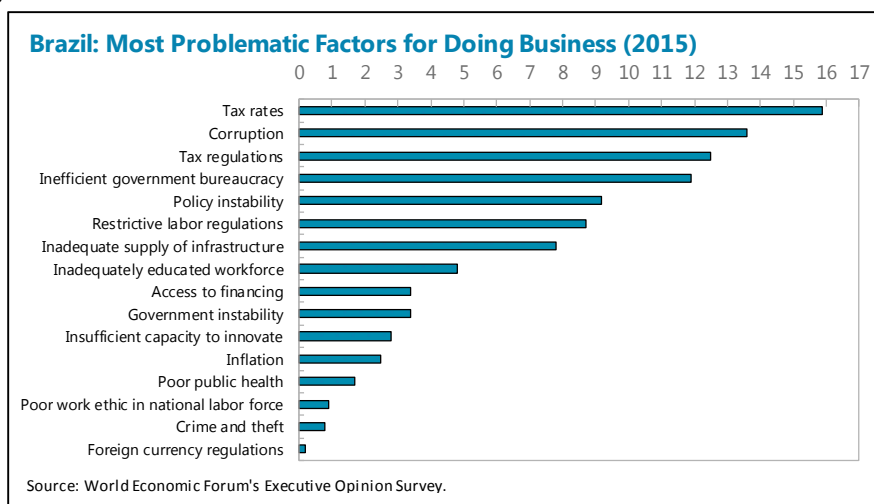
'favor-for favors', secret party funding, and suspiciously close ties between politics and business") and a low score on the *quality of bureaucracy*—2 out of 4—intended as freedom from political interference and interruption of government services. While these issues affect the

Source: International Country Risk Guide.

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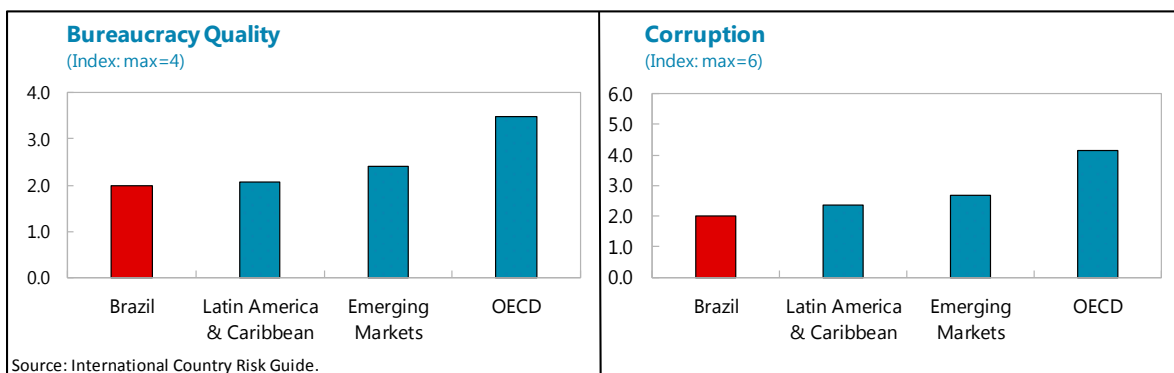
[5] In the sample, it takes on average 251 hours to comply with taxes, there are 25 payments, and the total tax rate is 40.6 percent. (World Bank, 2016, Paying Taxes 2017: The Global Picture, World Bank Group and PwC.) Taxes and contributions include: the profit or corporate income tax, social contributions and labor taxes paid by the employer, property taxes, property transfer taxes, dividend tax, capital gains tax, financial transactions tax, waste collection taxes, vehicle and road taxes, and any other small taxes or fees.

[6] From the list of factors, respondents to the World Economic Forum's Executive Opinion Survey were asked to select the five most problematic factors for doing business in their country and to rank them between 1 (most problematic) and 5. The score corresponds to the responses weighted according to their rankings.

operation of the government more directly, they tend to have repercussion on the business environment given that the public sector is a large customer, especially in the services industry in Brazil. Moreover, low trust in policies and corruption can make private sector less forward-looking and hamper accumulation of physical as well as human capital, constraining productivity gains.

Institution Related GCI Scores (2016-17)
Part I

Source: World Economic Forum.

Institution Related GCI Scores (2016-17)
Part II

Source: World Economic Forum.
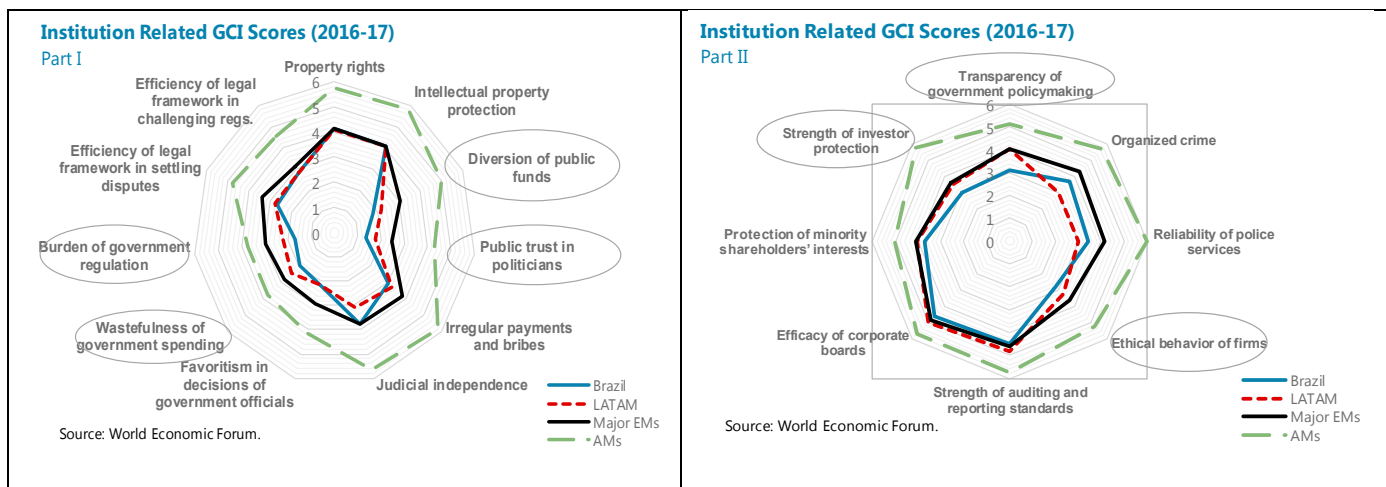
- **Trading across borders.** Brazil occupies a very low rank of 149 in this indicator. *DB* records the time and cost associated with the logistical process of exporting and importing goods.[7] Brazil's border compliance and import/export costs are among the highest in the world. It takes more than 5 days to acquire customs clearance and inspections for exporting from Brazil, and more than 15 days to clear imports, which is slower than for most of the countries in the world.

- **Getting credit.** Brazil occupies rank 101 in this indicator. Credit information is deep and Brazil's credit bureau coverage per adult is high, but the credit registry can be strengthened. Legal rights are also an area that calls for improvement.

- **Insolvency.** The insolvency framework has improved, but recovery rates below 16 percent of the value, are particularly low, and time to conclude the process (4 years on average) is long.

B. Recent Reforms Affecting the DB Score

6. **Brazil's business environment has changed over the past decade**. While many changes were positive, some worsened its position in international rankings. Some important changes in the policy environment, such as the expanded presence of public banks and the increased state intervention in the electricity and other key sectors, however, are not necessarily reflected in the list below, which corresponds to the standard criteria used in DB.

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[7] *DB* measures the time and cost (excluding tariffs) associated with three sets of procedures—documentary compliance, border compliance and domestic transport—within the overall process of exporting or importing a shipment of goods.

- **Starting a business.** In 2016, an online portal for processing business licenses was launched in Rio de Janeiro; although the opening hours of the Rio de Janeiro business registry were reduced, the overall effect should be positive. Improvements in the synchronization between federal and state-level tax authorities took place between 2009 and 2010.

- **Paying taxes.** Paying taxes became less costly for companies with the repeal of the tax on check transactions in 2011.

- **Trading across borders.** Over the past few years trading across borders has become easier thanks to an electronic system that reduced the time required for imports documentary compliance. Time for documentary and border compliance for exporting was also reduced by implementing the electronic SISCOMEX Portal system. These reforms came after a long period without upgrades as the last improvement in the electronic data interchange system before that took place in 2009.

- **Getting credit.** Private credit bureaus have been allowed to collect and share positive information since 2011.

- **Enforcing contracts.** Contract enforcement has been strengthened thanks to a new mediation law—that includes financial incentives for parties to attempt mediation—and a new code of civil procedure. In 2012, an electronic system for filing initial complaints was established at the São Paulo civil district court.

- **Registering property.** In 2012, transferring property became more difficult with the requirement of a new certificate on good standing on labor debts, adding to the number of due diligence procedures. Moreover, in 2015, in the city of São Paulo increased the property transfer tax.

C.   Announced Micro Reform Measures

7.   **The government has recently announced a package of micro measures seeking to improve the business climate by streamlining administration and reducing red tape.** While some of these measures will not be captured directly in the DB indicators, they have the potential to improve economic efficiency and facilitate the opening of the country. The timeline for their implementation is short, but the effects may take some time to materialize. The package includes 47 actions directly linked to the Ministry of Industry, Foreign Trade and Services (MDIC), or to agencies under the ministry's umbrella. Many measures—24 out of 47—are linked to foreign trade and consist of digitalization, computerization, and standardization of procedures.

- **Starting a business**. A National Network for Registration Simplification and Leading of Business (Redesim) will accelerate opening of new companies by integrating cadasters with registries and licensing bodies.

- **Paying (and collecting) taxes.** The government aims at simplifying procedures for tax refunds and the payment of labor and tax obligations. To that purpose an electronic collection system will be established (eSocial). The system currently only applies to taxes and contributions

collected from domestic workers and will be extended to unify 13 different obligations. Electronic invoicing used by the states and municipalities, and accounting information provided to the Federal Revenue will be simplified and standardized.[8] Moreover, the procedures undertaken by businesses to declare and submit tax-related documents will be streamlined. The reform of the overly complex *Programa de Integração Social* (PIS)[9] will simplify the definition of the tax base and thus reduce the currently high volume of litigation demands.

- **Trading across borders.** The agenda includes numerous measures to streamline the steps involved in import/export activities. A Single Foreign Trade Portal accessible via internet will consolidate the required documents including digital certificates of origin, simplify trade processes and customs transit, lowering the number of days necessary to export (from 13 to 8 days) and import (from 17 to 10 days). Other measures range from simple changes—such as ending the need to register to access the MDIC's official statistics online—to issues that affect the complex regime which grants exemption from import tariffs to exporters. Accreditation procedures for laboratories and organizations will be reviewed (Inmetro) and patent and brand registration procedures will also be standardized. Important efforts will be made to cut the waiting time for reviewing the annual reports of research and development projects which grant access to some tax breaks in the Manaus Tax Free Zone.

- **Labor productivity.** Recently approved in Congress, the Migration Law allows concession of working visas for citizens of other countries who are in possession of higher education diplomas. This measure may open the labor market to competition and could alleviate to some extent the pressures on the demand for skills in Brazil.

- **Getting credit.** Improvements will affect the positive credit registry and reduce informational asymmetry; a centralized market for electronic credit card and other receivables will be created; legislation for the fiduciary alienation of immovable property that goes to auction will be strengthened. Improvements of the Bankruptcy Law aim to empower creditors, promote extrajudicial recovery, streamline processes, and strengthen the rights of the acquirers of the company.

- **Other measures**. The government has committed to implementing a broader set of measures affecting the labor market, the payment system, and some credit allocation mechanisms. An attempt is being made to coordinate a settlement of tax and social-security debts of companies; large companies' debts to the Brazilian Development Bank (BNDES) under the Investment Support Program (PSI) are under renegotiation to support deleveraging and step up growth on new credit and activity; small and medium-sized companies' debts are also being renegotiated. Other micro reforms include authorization for merchants to charge different prices for purchases

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[8] This has already been implemented in São Paulo, Fortaleza and Porto Alegre municipalities.

[9] PIS is the contribution paid by companies to finance unemployment insurance and dismissal of employees who earn up to two minimum wages.

paid in cash or with card; the reduction in the period for repayment and in the cost of revolving credit to the consumer, and the standardization of forms for commercial establishments.

D.   External Competitiveness

8.   Brazil's external sector performance has deteriorated in recent years.[10] Since the global financial crisis, investment, export growth and market efficiency have declined relative to peers. High unit labor costs, inadequate infrastructure (IMF Working Paper No. 15/180), elevated tariffs, and high rigidities in factor, goods, and financial markets have reduced openness and compressed Brazilian exporters' shares in global markets. Export volumes performance no longer surpasses peers. Brazil witnessed strong export performance up to the global financial crisis,[11] in the upper quartile of major EMs.[12] However, following the crisis, its volume path has converged to the median of major EMs. This reflects, inter alia, ample swings in the REER during the 2000s—a large depreciation in the first half and appreciation thereafter, in sharp contrast with other EMs and LATAM countries. (That said, export volumes in some EMs, especially in Asia, may be inflated by re-exports of goods because of their integration into global value chains.)

Export Volume (2000-15)
Goods and Services. Index: 2000=100

Source: WEO.

Terms of Trade and REER (2000-16)
Emerging markets. Index: 2000 = 100

Sources: INS and WEO.

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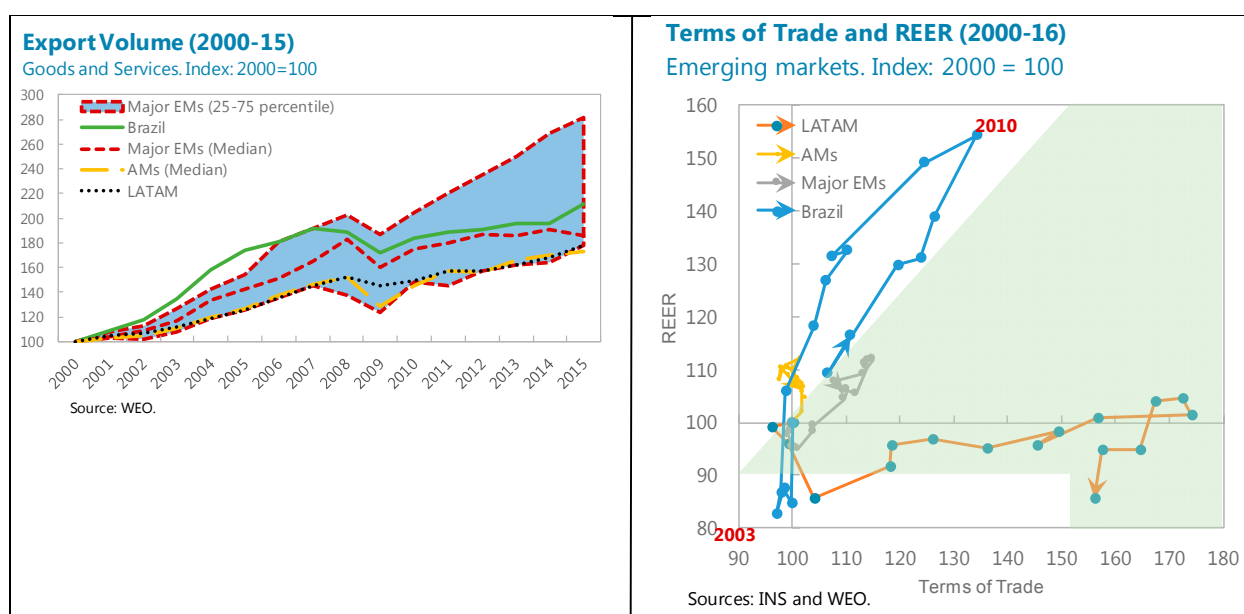
[10] Canuto et al. (2013) and OECD (2015).

[11] This is a robust observation even with the trade volumes are normalized as 1995=100.

[12] The sample includes: Argentina, Chile, China, Colombia, Egypt, Hungary, India, Indonesia, Malaysia, Mexico, Morocco, Peru, Philippines, Poland, Romania, Russia, Thailand, Tunisia, Turkey and South Africa. AMs follow the WEO classification.

Export Diversification
(HH Index)

Source: WITS.

Exports: Change in Domestic Value Added
Share in Major EMs

$$y = -0.367x + 21.937$$
$$R^2 = 0.3385$$

Sources: OECD and WTO.
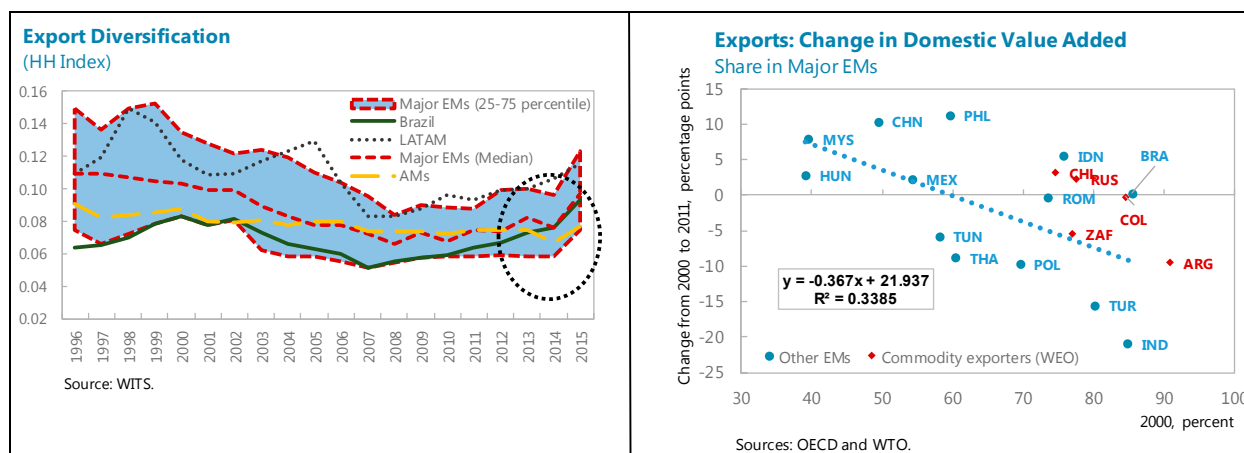
9.   Brazil's exports are diversified,[13] but this advantage appears to have diminished recently. The Herfindahl concentration index was in line with the EM median in 2014–15, up from lower levels registered over the past two decades. The domestic content of Brazil's exports, based on value added trade data compiled by the OECD and WTO, has been persistently higher than its peers' pointing to the weight of commodities in Brazilian exports and the country's lower integration into global value chains.[14] Brazil's export quality, compiled by Henn et al. (2015),[15] is well below average implied by the frontier of other major EMs and advanced economies (AMs).[16]

E.   Factors Explaining Deteriorating Competitiveness

While aggregated macro indicators, such as export volumes, are common summary statistics, they may be affected by numerous factors. This suggests the analysis needs to be complemented by micro indicators.

10.   As shown in other studies, trade liberalization appears to have stalled in Brazil after the large reduction in tariffs in the early 1990s. Tariffs in Brazil are higher than in its peers, despite efforts to liberalize trade since the early 1990s (Box 1). While import tariffs in Brazil have declined since the early 1990s to below 10 percent, Brazil's tariff regime is currently more protectionist than the average in Latin America and the Caribbean (LAC) and the upper middle income country average. Disaggregated data suggests that goods and other raw materials tariffs are substantially higher than Brazil's peers', especially on capital goods.

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[13] Ding and Hadzi-Vaskov (2017) report a similar observation.

[14] Lower integration into global supply chains could explain part of the recent export volume developments in Brazil.

[15] Henn et al. (2015) also reported that institutional quality, liberal trade policies, FDI inflows, and human capital could promote quality upgrading.

[16] Commodity exporters generally display higher domestic content in exports and lower export quality.

Box 1. History of Trade Liberalization in Brazil

**By the late 1980s, Brazil's import policy exhibited the following basic characteristics** (Cardoso 2009):

- Tariff structure was still largely the same as in 1957.

- Generalized presence of tariffs with redundant quotas.

- Various additional taxes, such as financial transaction tax, port improvement tax, and additional tax for renewal of maritime transportation.

- Ample use of Non-Tariff Barriers (NTBs), such as a list of products with suspended import licenses, specific advance authorization for certain products (steel and IT products) and annual corporate import quotas. Cardoso (2009) estimated that tobacco, real estate, plastic products, clothing, footwear and textile products, perfumes, soap and candles, and transport material were most protected by the barriers in 1987.

- The existence of 42 special regimes, allowing for the exemption or reduction of taxes.

Liberalization occurred during the early 1990s. Trade liberalization, including the three tariff reduction waves, was implemented during 1988 and 1994. In the first phase (1998–89), two tariff reforms were undertaken seeking to eliminate the redundant share of the nominal tariff without significantly impacting import volumes. The second phase (1991–93), gradual import tariff reductions, was implemented after NTBs were abolished in 1990, with imports being controlled through import tariffs. The third phase (1994) intended to discipline domestic

Brazil, Tariff Rates (1990-Latest)
Weighted average, percent

Source: World Integrate Trade Solution (WITS).

prices through greater external competition. In response to these measure, and alongside measures taken in 1994 to facilitate the implementation of a stabilization plan (the Real Plan), the weighted-average tariff declined substantially.
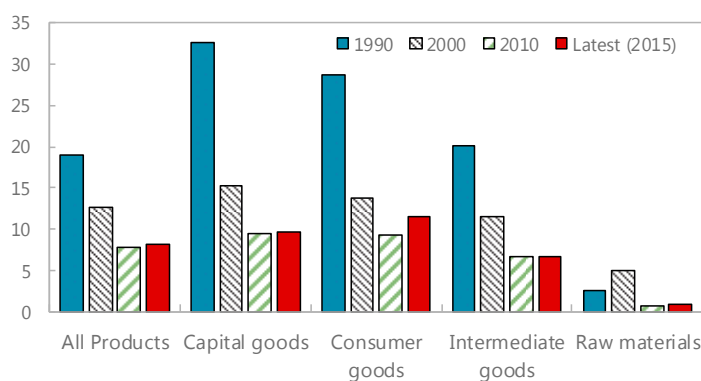
But there was a partial reversal thereafter. The liberalization during the first half of the 1990s, however, soon gave way to a reversal as Brazil entered a period of increasing current account deficits driven by a severe exchange rate appreciation and negative external shocks (Moreira 2009). In November of 1997, the government temporarily raised the tariffs by 3 percentage points. After that, the weighted average of tariff rates demonstrated a very gradual decline until the global financial crisis, and gradually increased since then. De Araujo Jr. (2017) pointed that frequent use of anti-dumping, especially after 2008, has contributed to eroding competitiveness by keeping domestic prices high and reducing competition in domestic markets.

The literature identifies a positive link between trade liberalization and productivity. Lopez-Córdova and Moreira (2004) reported that the trade liberalization of the first half of the 1990s made a substantial contribution to lowering prices of capital goods in Brazil, estimating that a 10 percent reduction in tariffs increases total factor productivity (TFP) by 1 percent. Lisboa et al. (2010) used firm-level data and found that the reductions of tariffs on inputs were important in explaining productivity growth during trade liberalization in Brazil. Tariff reduction in products that are mainly used as inputs affect productivity growth.

11. **Investment in Brazil has been weaker than in its peers**. Investment shows some correlation to tariffs on capital goods across countries. Because weak investment relative to peers was persistent in Brazil, the quality of its capital stock has deteriorated. The slow growth and the aging of the capital stock has constrained marginal productivity of labor, limiting its growth potential.

Figure 1. Brazil: Investment and Tariffs: Brazil and Emerging Markets

Brazil and Major EMs, All Products, Tariff Rates, 1996-Latest
Weighted average, percent, median

Source: World Integrate Trade Solution (WITS).
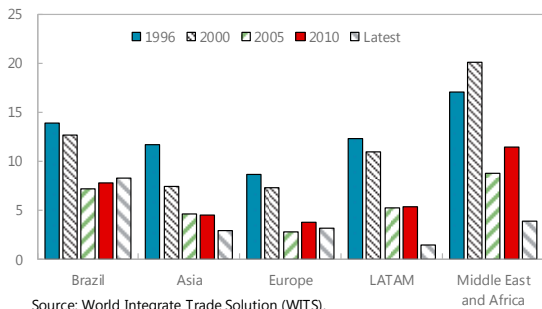
Tariffs across EMs, Latest
Weighted average

Source: World Integrate Trade Solution (WITS).
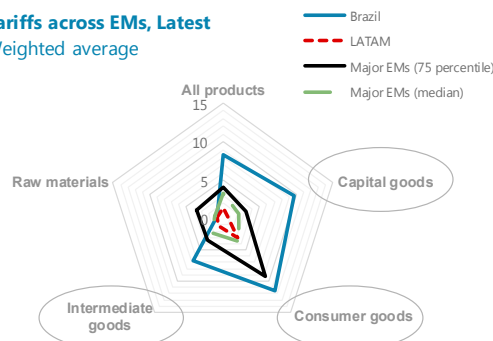
Gross Fixed Capital Formation (2000-16)
In percent of GDP

Source: WEO.
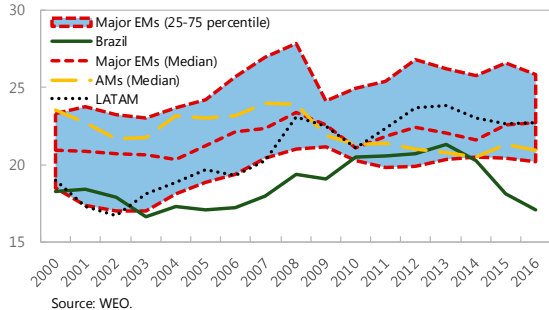
Tariffs on Capital Goods and Investment (2011-15)
Major EMs, excluding China

y = -0.4022x + 24.661
R² = 0.0498

Sources: WITS, WEO.
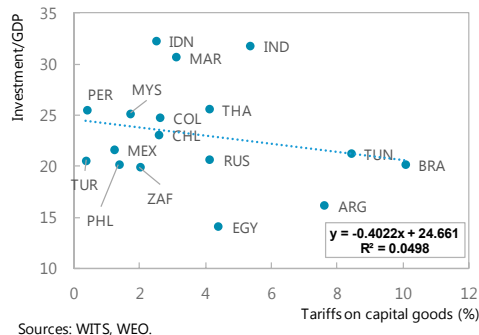
Major EMs. Vintage of Capital Stock, 1990-2021
Median

Sources: PWT 9.0 and WEO.
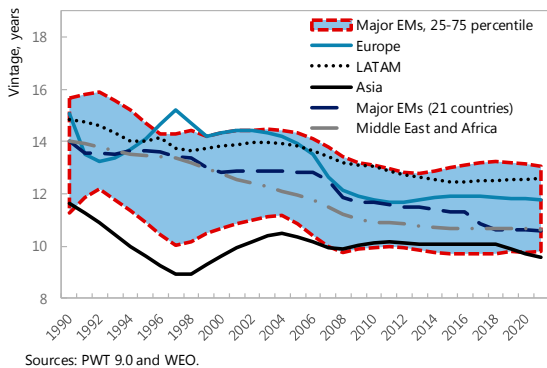
Capital Stock Vintage and ICOR (2010-16)
Major EMs, excluding China

More investment is needed to support growth

y = 0.0158x + 0.2
R² = 0.1635

Sources: WEO and PWT
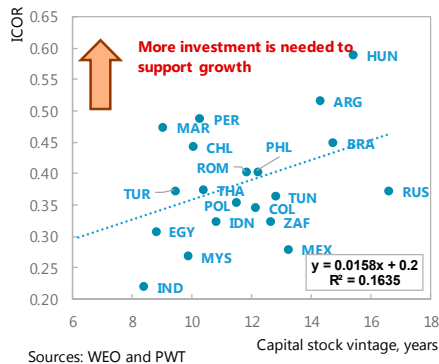
12. Non-tariff measures are used extensively in Brazil. Quotas and special safeguards are more common in Brazil than in LAC countries on average (Cardoso 2009). OECD (2014) finds that Brazil is second only to Indonesia in the number of local content requirements imposed since the global financial crisis. However, restrictions to inward FDI are close to peers. Brazil has fewer restrictions on FDI than Asian and European EMs,

FDI Restrictiveness Index (1997-2015)
Higher number indicates more restrictive, average

Source: OECD.

although its relative advantage appears having diminished recently. FDI has a role not only for the financing of current account deficits but also for transferring technology/stimulating productivity gains.
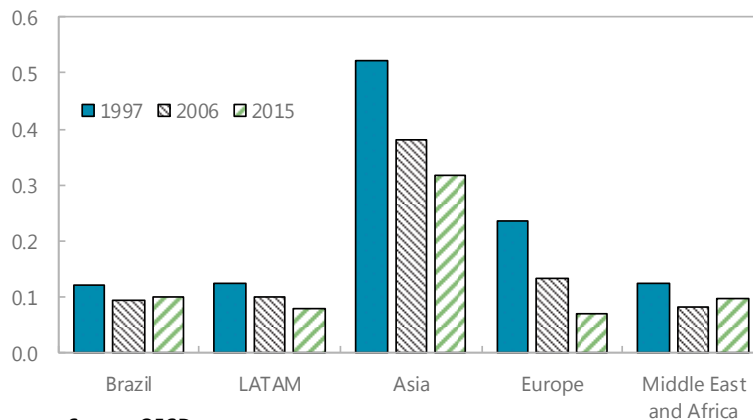
Figure 2. Global Competitiveness: Brazil and Emerging Markets

Labor Related GCI Scores, 2016-17

Goods Markets Related GCI Scores (2016-17)

Source: World Economic Forum.

Financial Sector Related GCI Scores (2016-17)

Source: World Economic Forum.

Box 2. Literature on the Impact of Trade Liberalization on Productivity and Growth

Theoretical literature points to several channels through which trade liberalization can boost productivity and external competitiveness (Ahn et al. 2016).

- **Competition**. Lower trade and FDI barriers can strengthen competition in the liberalized sector(s), by putting pressure on domestic producers to lower price margins, exploit economies of scale, improve efficiency, absorb foreign technology, or innovate.

- **Scale.** Productivity gains from liberalization may accrue disproportionately to larger and more productive firms, enabling them to gain market share and amplify aggregate gains within the liberalized sector.

- **Lower input costs.** Trade liberalization, which includes local content requirements, can boost productivity by increasing the quality and variety of intermediate inputs available to domestic producers.

But higher productivity does not necessarily imply sustained higher growth. As demonstrated by Bajona et al. (2008), standard trade models—including Ricardian models, Heckscher-Ohlin models, monopolistic competition models with homogeneous firms, and monopolistic competition models with heterogeneous firms—at best predict that trade liberalization increases welfare, but does not necessarily sustain real GDP growth. Trade liberalization improves resource allocation, but the real income gains may be limited to the period during which trade liberalization occurs (Moreira 2004).

Sectoral and firm-specific factors are also important for growth. Mechanisms outside of those analyzed in standard trade models can help liberalization lead sustained higher growth. Recent theoretical and empirical evidence suggests that the impact of trade liberalization varies widely across firms, depending on their individual characteristics, such as ownership structure (foreign owned vs. domestic), the extent to which they use imported inputs, and the degree of competition in their industry (Ahn et al. 2016). Also, the treatment of the nontraded sector is important in determining the magnitude of liberalization's effect on labor productivity (Kovak 2013). This suggests that interactions between trade liberalization and other policies, such as product and labor market regulation or barriers to FDI that could affect firm characteristics is important.

The degree of integration matters too. Also, the degree and quality of the integration, both in terms of trade-to-GDP ratios and the level and structure of protection, tend to have a major influence in the end results of trade liberalization (Moreira 2004). Gains from trade are maximized when a country not only opens its own market, but when it also enjoys access to markets abroad (Moreira 2009). Monfort (2008) summarizes that benefits from an FTA mostly stem from non-trade channels, inc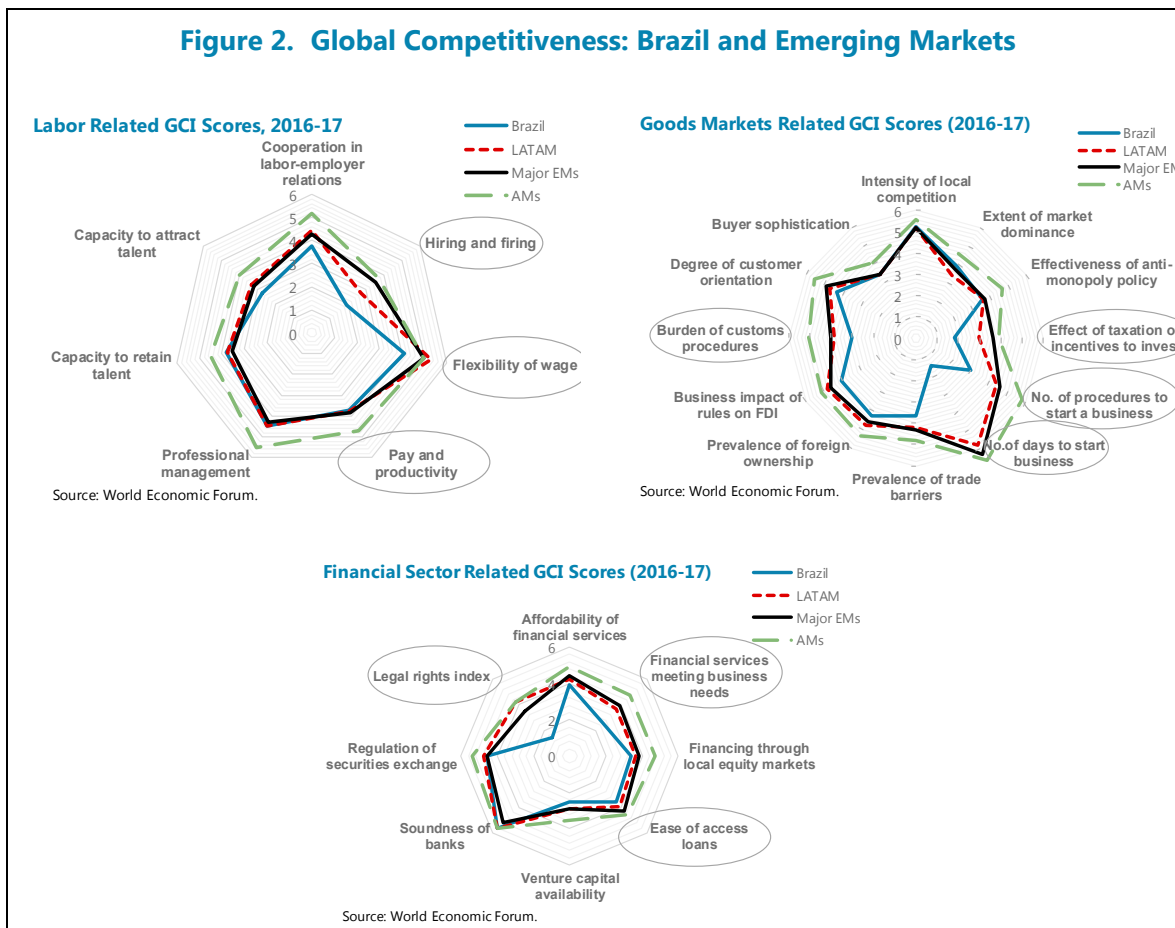luding reduced risk premiums, increased foreign direct investment, or improved factor productivity, rather directly from trade. Beaton et al. (2017) employed a large panel data set to show that growth is positively affected by trade openness, trade partner diversification, integration to global value chains, and export quality. Hannan (2017) found that trade agreements in Latin America have generated substantial growth in exports, although the export gains in Latin America were more limited than the world average, possibly reflecting the region's lower trade openness and weaker integration into global value chains.

Empirical, cross country studies have underscored gains in productivity and growth from trade liberalization (Goldberg et al., 2004). Wacziarg and Welch (2003) employed an event study approach using aggregate cross country data to find the robust positive effect of trade liberalization on growth. Ahn et al. (2016) used data of effective tariffs in 18 sectors across 18 advanced countries spanning over two decades and found a significant and robust impact of input tariff liberalization on sector-level total factor productivity (TFP)— a one percentage reduction in input tariffs raises TFP levels by about two percent. Krishna and Mitra (1998) investigated the effects on competition and productivity of the dramatic 1991 trade liberalization in India. Using firm-level data, they found (i) strong evidence of an increase in competition and (ii) some evidence of an increase in the growth rate of productivity.

> ### Box 2. Literature on the Impact of Trade Liberalization on Productivity and Growth (Concluded)
>
> **Liberalization must be supported by other structural policies.** Benefits of trade liberalization can be enhanced through coordinated measures to improve non-trade factors such as foreign investment, rigidities in labor and product markets, and global markets' integration. OECD (2011) reported a substantial improvement in real GDP from a coordinated reduction in trade costs related to tariff and non-tariff barriers, but most of the improvement was driven by a decline in non-tariff barriers. Rahman et al. (2015) found a strong role of structural reforms for taking advantage of the tariff-free trade environment to export in new member states of EU. Especially, they reported that (i) policies that influence higher education and skills match, incentives to work, and foreign investment environment are most relevant and (ii) reform sequencing becomes important for export quality improvement.[1] Also, Baniya (2017) found that timeliness of delivery of goods constitutes a comparative advantage of exports. IMF (2015) also showed that despite the positive effect of trade agreements on exports they need to be accompanied by structural reforms and reduction of non-tariff barriers.
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> ─────────────
>
> [1] A conducive environment for foreign investment and greater links with supply chains are key for countries at the lower end of quality spectrum, while tertiary education, skills upgrade, and R&D spending are priorities for countries at the medium-level of quality spectrum.

F.   Benefits of Furthering Trade Liberalization in Brazil

13.   Trade protection should be reduced steadily by lowering tariffs, removing non-tariff barriers and scaling back local content requirements, including on public procurement. OECD's extensive quantitative analysis on the impact of trade liberalization, as well as the work of other analysts, points to substantial gains from liberalization, if appropriately implemented. Lowering barriers to trade allows firms to use a higher share of foreign intermediate goods in production. Final goods are thus sold at lower prices, enhancing the competitiveness of Brazilian exports while also benefitting Brazilian households. In addition, lower barriers to trade reduce the cost of capital, spurring investment and supporting further expansion of production.

- OECD (2011) presented a simulation derived from large scale global general equilibrium models to assess the effects of the coordinated reduction in trade costs related to tariff and non-tariff barriers. The main policy scenario assumes that G20 member countries implement a 50 percent MFN tariff reduction and a reduction of non-tariff barriers by 50 percent on an MFN basis. The estimated impact for Brazil is an increase in the real GDP by about 7½ percent over the long-run, most of it driven by a decline in non-tariff barriers.

- Araujo and Flaig (2016) used a computable general equilibrium model to study the impact of trade liberalization.[17] The simulation assesses the impact of a reduction in import tariffs (to the OECD minimum level), local content requirements (eliminate all requirements), and taxes levied on exports (to zero) in Brazil. The results show that: (i) aggregated production level in Brazil would increase by about 1.7 percent, driven by a pick-up in exports; (ii) lifting impediments to

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[17] This is a comparative static, constant returns to scale multi-region Computable General Equilibrium model that captures inter-industry effects while tracking differences in trade patters by individual country and sector. For details, see Box 2 in Araujo and Flaig (2016).

trade would allow a deeper integration to global value chains, as implied by the substantial growth in some manufacturing sectors and non-ferrous metal exports; and (iii) the largest gains in production would stem from zero-tax rates on exports, while for exports the gains would come from eliminating tariffs on imports of intermediate goods.

- IMF (2017) analyzes the impact on investment of tariffs levied on capital goods. The result indicates that, if Brazil halves its average tariffs on capital goods (about 10 percent in 2015), it would increase investment by about 10 percent over the medium-term. Halving tariffs on capital goods in Brazil would raise its investment-to-GDP by about 2 percentage points. This is equivalent to an increase in investment of about 15 percent over three years assuming a real GDP growth of 2 percent on average.[18]

14.   Greater integration into the global economy should improve external competitiveness. Recent studies on LAC countries show significant gains in external competitiveness and potential growth occurring through trade openness and participation to the global value chains.

- Beaton et al. (2017) and Cerra and Woldenmichael (2017) show a statistically significant positive impact of trade integration (openness and integration to global value chains) to growth. Based on their estimated parameters, the probability of export surge in Brazil could increase by about 8 percentage points, if the degree of globalization in Brazil, measured by the KOF index of globalization,[19] increases from the latest reported level to its frontier implied by per capita income among AMs and major EMs. Also, raising the degree of participation in global value chains from the current level (slightly below the 10th percentile) to the 25th and 50th percentiles of AMs and major EMs would raise annualized growth by 0.15 percent and 0.3 percent, respectively.

- Cerdeiro (2016) simulated the effects of the TPP in Latin American countries, both the TPP and non-TPP member countries, using a multi-sector model. While the prospect of TPP is highly uncertain, the study can still highlight the potential gains for Brazil by joining large "mega" trade agreements. First, liberalization of tariffs and non-tariff barriers in TPP members would reduce exports in percent of GDP by 0.2 percentage points. Second, expanding the TPP to include nine Latin America and Caribbean (LAC) countries,[20] including Brazil, would raise real income in Brazil by 0.4 percent.[21] Also, using the estimated parameters in Beaton et al. (2017), increasing the

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[18] This assumes constant investment and GDP deflators.

[19] The index is defined over three dimensions: *economic globalization*, characterized as long distance flows of goods, capital and services as well as information and perceptions that accompany market exchanges; *political globalization*, characterized by a diffusion of government policies; and *social globalization*, expressed as the spread of ideas, information, images and people. For details, see http://globalization.kof.ethz.ch/.

[20] Argentina, Bolivia, Brazil, Colombia, El Salvador, Guatemala, Nicaragua, Paraguay and Uruguay.

[21] The simulation assumes a full tariff liberalization and a decline in non-tariff barriers to the levels of those of TPP members with less restrictive trade regimes.

number of trade partners in agreements to the 25the and the median of AMs and major EMs would raise annual growth by 0.5 percent and one percent, respectively.

15.   Progress in expanding and diversifying bilateral, regional and multilateral trade agreements will be key for further enhancing integration. Until recently, Brazil has, through Mercosur, developed an extensive network of tariff agreements in the region. Trade agreements cover goods, services, investment, trade facilitation, technical regulations and government procurement. The network has been further extended to Cuba, Guyana and Saint Kitts and Nevis. Diversification of trade agreements, especially with the countries of the Pacific basin (Peru, Chile and Colombia) was also sought. The government intends to expand trade agreements with Mexico while negotiations to conclude the Mercosur agreement with the EU, which accounts for 20 percent of trade of the block, were resumed. Moreover, the bilateral agenda with the U.S., including the implementation and expansion of the agreements on Regulatory Convergence and Trade Facilitation, has been already signed.

16.   Reforms in product and labor market regulation are critical for improving external competitiveness. In this context, it would be recommended:

- strengthening competition by streamlining regulation on product markets and implementing planned reductions in entry regulations;

- improving the technical capacity and planning for infrastructure concessions and elaborating more detailed tender packages prior to launching tender calls;

- consolidating indirect taxes at the state and federal levels and working towards a value-added tax with a broad base, full refunds for input and zero-rating of exports; and, more broadly,

- pursuing DB reforms.

G.   Conclusions

17.   Brazil can boost productivity through reforms aimed at improving the business environment and external competitiveness. As argued in numerous studies, lowering tariff and non-tariff barriers can enhance trade integration, improve economic efficiency, and boost investment and growth. But pursuing trade agreements, over and above the Mercosur partnership, bears promises of further global integration of Brazil and stronger growth. Product and labor market regulation reforms are also important for strengthening channels through which the business environment affects competitiveness and trade, as are reforms to the tax system. Implementation of trade measure should, however, consider the cyclical position of the economy: tariffs reduction could increase competition forcing some inefficient firms to exit from markets. Although this would increase productivity over the long run, it could result in higher unemployment and lower consumption in the short-run. This suggests that reforms should be carefully sequenced, paying attention to their potential contractionary impact on economic activity as the economic transformation unravels (IMF, 2016c).

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DISTRIBUTIONAL EFFECTS OF BRAZIL'S PENSION REFORM[1]

A. The Reform of Social Security

1.   Brazil social security system faces large current and growing future financial imbalances absent reforms. With increasing average benefits relative to contributing salaries, and a rapidly aging population, Brazil's social security system cannot be sustained in the future without reform. Pension spending competes with productive outlays, and, at current trends, may hinder government's ability to provide other public goods.[2]

2.   The Congress is currently debating a social security reform. This reform addresses many of the main sources of financial imbalance under the present system. The proposal introduces a minimum retirement age for women and men, with some transitional arrangements, extends the minimum contribution period, and adjusts the benefit payable at retirement. In addition, the reform would over time reduce differences in the regimes for private and public sector employees. The reforms would also limit the scope for the accumulation of benefits, such as a retirement benefit and a survivors' pension, and lower the rural pension subsidy (see Appendix I for more detail).

3.   Taking into account the transition to the new system, the reform will affect formal workers who are employed currently, especially those who are farther away from retirement. By bringing closer the various parameters of the private and public pensions systems, the reform will do much to narrow inequalities over time. But since the reform

Sources: World Development Indicators; and IMF Staff estimates based on a sample of about 100 countries.

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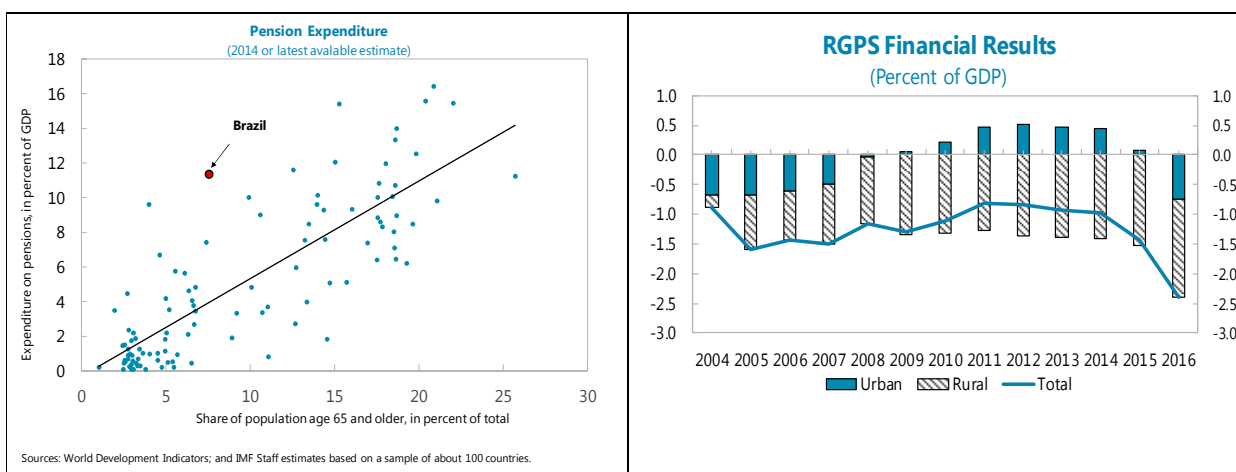
[1] Prepared by Izabela Karpowicz (WHD), Vivian Malta, and Marina Mendes Tavares (SPR).

[2] See Cuevas and others (2017) for a more comprehensive description of the social security system and a discussion on pension system sustainability. Brazilian usage typically requires calling retirement programs "*aposentadorias*" while reserving the term "*pensões*" for other specific benefits, such as a survivor's or a disability benefit. In this chapter we will use the terms "pensions" and "social security" interchangeably, and encompassing all of these various social security programs, unless explicitly indicated otherwise.

modifies various parameters in the private system too, including contributions, retirement incentives and the value of benefits, it will affect not only the pension system's sustainability, but also the distribution of income across various categories of workers.

- *The minimum retirement age for men and women and higher minimum contribution time*: postponing retirement implies working and earning wages longer, thus contributing to the pension system for longer and receiving retirement benefits for a shorter time. Typically, however, in a defined-benefit system, benefits claimed at the time of retirement would be higher because they would be calculated based on a salary history which includes the additional time earning (higher) wages. However, longer required years of contribution can create disincentives to participate in formal work for workers with spotty careers, who are typically low-wage earners, because they may be able to qualify for non-contributory pensions before they can complete the (longer) minimum contribution period.

- *A new benefit formula*: in the reform under consideration, replacement rates would decline for all individuals who contribute for less than 40 years, which is the time it takes to claim a full pension under the proposed new rules. Changes in the formula would have a relatively smaller impact on pensioners who currently retire based on contribution-time alone because these individuals tend to have substantially long contribution histories anyway. The changes do not affect individuals who would receive the minimum pension, which is equal to the minimum wage.

- *Tightened access to rural pensions and BPC*: increasing the minimum retirement age for non-contributory pensions could have a negative impact on lifetime earnings of rural workers and urban workers who receive the BPC as they will be receiving the minimum pension (as before), but for a shorter time.

- *Limited cumulation of benefits (survivors' pensions)*: limiting the accumulation of benefits would lower beneficiaries' total incomes; however, a third of survivors' pensions goes to the 10 percent richest families.

B.   Stylized Facts on the Social Security System and Inequality

4.   **At present, there are large differences in benefits received by private sector and public sector employees.** Public sector workers enjoy higher wages during their productive life, at all points in their career and across most professions; the public-private wage differential seems to be around 50 percent based on the 2014 PNAD (see Chapter 4).[3] Moreover, public sector workers generally retire earlier than private sector employees under existing rules, have higher average post-retirement incomes, and their retirement benefits are often subject to larger annual revisions than those of their counterparts in the private sector.

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[3] Pesquisa National por Amostra de Domicílios (PNAD).

Median Monthly Earnings, by Age
(In reais of 2015)

Urban Private Sector — Rural Private Sector — Public Sector

Sources: PNAD.

Distribution of Earnings 1/
(Percent)

Minimum wage

Income Deciles

Urban Private Sector ☒ Rural Private Sector ☐ Public Sector ■ Retirees & Survivors 2/

Sources: PNAD; and IMF staff calculations.
1/ All earnings (from labor or pension) of workers (formal or informal) ages 18 and above.
2/ Individuals receiving pensions (those who work and those who are retired).

5.   The pension system seems to reinforce other sources of inequality. Pension benefits are unequal in part because the option to retire by length of contribution is most easily exercised by earners with stable formal sector jobs. Moreover, many high-income workers retire by time of contribution at a relatively early age, and then continue to work in the private sector while they draw a pension. The highest net benefit (public transfer), defined as the difference between total benefits received post-retirement and total contributions paid during a person's working life, accrues to richer individuals—public workers and high skilled private workers—under the current system. In fact, the World Bank (2017) estimates that around half of all pension "subsidies" country-wide accrues to the top income quintile of the population, while only 4 percent accrues to the bottom 20 percent.

RGPS Retirement Benefits, 2016
(Average monthly reais)

Ave. National Income
Min. Wage

Total   Urban   Rural

■ Age   ☒ Invalidity   ☐ Length of service

Sources: Previdência Social; and IBGE.

Average Monthly Earnings (Age 55-65), 2015
(In reais)

	All	Skilled	Unskilled
Private urban workers	2,002	6,448	1,539
Retirees who work	3,898	8,999	2,661

■ Private urban workers   ■ Retirees who work

Sources: PNAD; and IMF staff calculations.

6.   Inequalities persist also within the RGPS at the urban/rural level. Skilled workers in urban areas have sufficiently long contribution histories to retire by contribution time, especially men. In rural areas, workers, in particular women, retire according to age (men aged 60 and women aged 55 who have completed at least 180 months of work in family agriculture) and receive a benefit equal to one minimum wage, which we call hereafter "rural pension". The number of beneficiaries of rural pensions is higher than the rural

population above 55 per IBGE estimates, across all states, suggesting that there may be abuse in the system.[4]

Share of Total Monthly Benefits by Income Level, 2017

Source: Previdência Social.

RGPS Social Security Benefits, 2017

Source: Previdência Social.
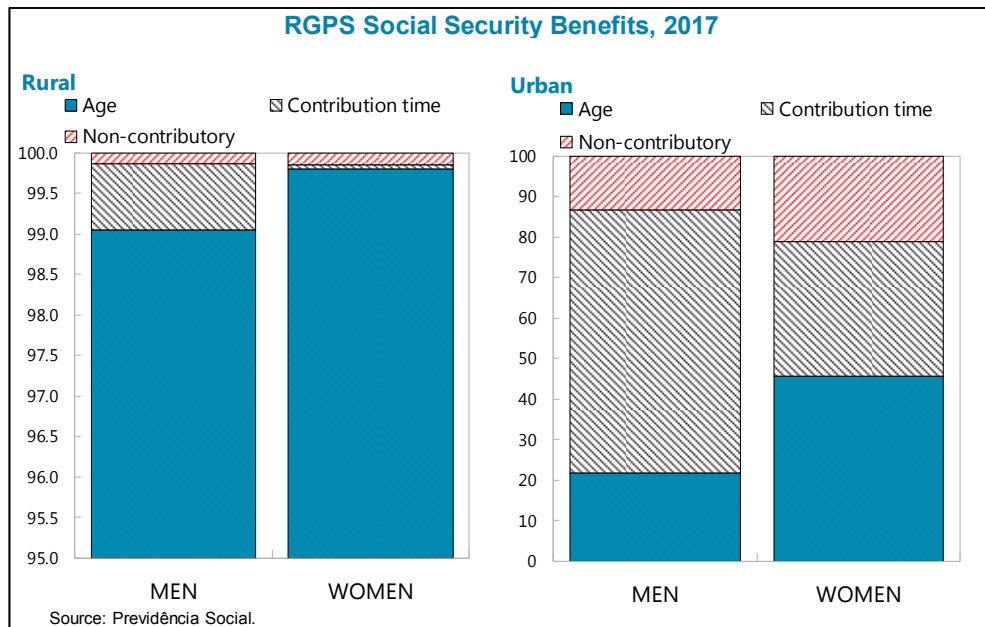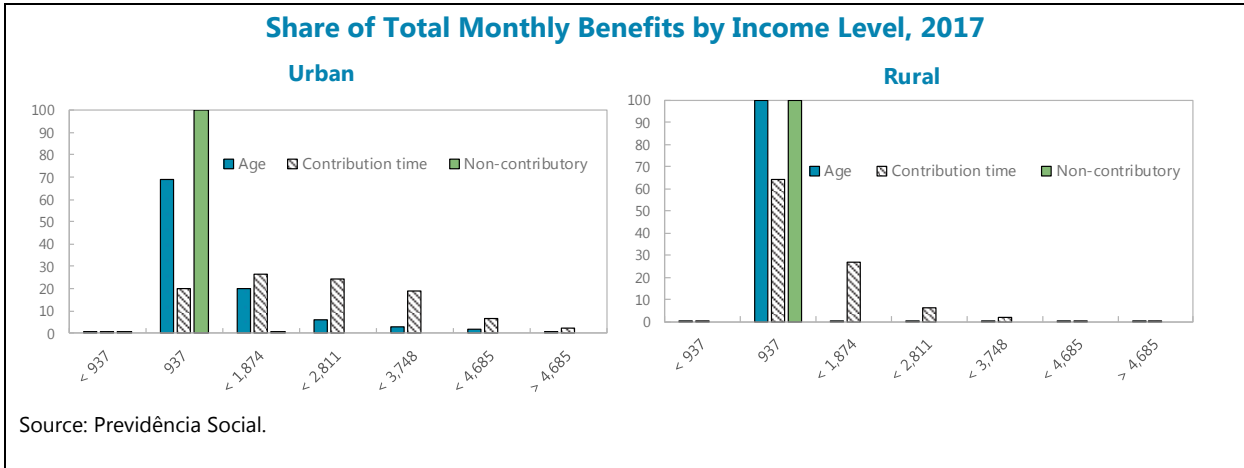
7.   Some benefits with a social assistance component could be better targeted. The BPC-LOAS are pension-like assistance benefits available to those who do not qualify for a retirement benefit based on the two conditions mentioned above. These assist individuals who are 65 and above or disabled and whose household income per capita is below ½ of the minimum wage. They receive an amount equal to the minimum wage and their conditions are reviewed every two years. Due to possible duplication and recourse to jurisprudence, this benefit is not well targeted to low-income families: around 40 percent of these benefits accrue to the top two quintiles of the population and over 10 percent to

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[4] Intituto Brasileiro de Geografia e Estatistica (IBGE).

the bottom two deciles (World Bank, 2017). The reform proposes to increase the minimum age for obtaining the benefit.

C.   Some Distributive Effects of Pension Reform

8.   How will the pension reform affect gross and net incomes of contributors? We analyze the effects of the proposed changes in the social security on the "lifetime incomes" of various "representative agents" or "ideal types" (defined here to include their earnings from work, retirement benefits, and any pensions they leave to their survivors), and the net lifetime transfers they receive from (or pay to) the social security system. Each agent is a different type of worker (and future retiree), whose lifetime earnings trajectory is constructed with data from Brazil's continuous households survey (PNAD, 2015). We show that in the new steady state, after the transition period is over, the proposed reform will affect lifetime incomes of private unskilled, public and rural workers only marginally while skilled urban workers will earn more because they will be required to work longer.[5] Nevertheless, the reform has an important component of progressivity: it would reduce the high net transfers that currently flow to the higher income workers (and their survivors).

9.   Below, we show the estimated lifetime income path for four representative male workers. We consider a median worker who dies at age 80 and leaves a survivor's pension to his spouse (but no other dependents), who lives for another 12 years. The assumption is based on conditional death probabilities from IBGE (for men and women) and their average age difference, 9 years, in the survey. We select four profiles: skilled urban, unskilled urban, rural, and government workers; for each of these types, we construct a predicted curve of real earnings over a lifetime using PNAD cross-sectional data on median earnings by age.[6] We assume that workers who retire do not continue to earn wages from active work thereafter; and that a postponement of retirement corresponds one-for-one to a lengthening of the working life. In our examples, skilled workers are those who hold a university degree. Monthly lifetime earnings in the profiles are expressed in gross terms, before taxes and social security contributions.

10.   The four types are illustrative, and by no means exhaustive. One could construct other examples for women, for people who continue to work after retirement, for people who have surviving children or no survivors at all, for people who move from the private to the public sector halfway through their lives, for people who are caught in the transition between the old and the new systems, and so on. The objective is not to span all the possibilities, and not even to study "representative" cases in any statistical sense, but to develop a few examples that can provide a sense of some of the distributional effects that can be expected of the reform.

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[5] We are evaluating the most recent reform proposal (see Appendix for more detail on the changes in parameters).

[6] We estimate a Mincer regression with "Age" and "Age^2" for each of our four types. There are significant variations in wages in the survey, in particular for public workers.

11.   Overall gross lifetime income of the urban (private) sector skilled worker would increase because of the reform. Without the reform, skilled workers with full contribution history would retire on average at age 56 after 35 years of contribution. They would enjoy a retirement benefit indexed to inflation till death and leave the full benefit to the spouse, who would enjoy it for another 12 years on average. We consider now what would happen under the proposed reform in the new steady state (that is, after the 20-year transition period is over) to a similar individual. Because of the introduction of a minimum retirement age, the private, skilled worker would postpone retirement. We assume that this individual would work for 45 years and retire at age 65. He would thus earn a wage for a longer time, enjoy a retirement benefit for a shorter period, and leave a survivor's pension to the spouse that would be lower under the new rules.[7] His net lifetime income, after accounting for taxes and contributions, would also be higher than before the reform.

12.   For workers with an incomplete contribution history, who already retire based on old-age, the effect on the overall lifetime income from postponing retirement would be negative but small. We assume that unskilled workers, some 65 percent of which earn up to two minimum wages (Appendix I, Figure 1), contribute for 15 years currently but their contribution time increases to 25 years after the reform. The period during which they receive retirement benefits would remain the same but the benefit level would be lower because it would be calculated over the entire contribution history (not the 80 percent highest wages, as it is currently the case). Survivor's pension would also decline.

Real Income of Urban Worker, Skilled (Constant R$ of 2015) — Before Reform / After Reform / Minimum Wage; x-axis: Age 20–90

Real Income of Urban Worker, Unskilled (Constant R$ of 2015) — Before Reform / After Reform / Minimum Wage; x-axis: Age 20–90

Sources: PNAD; and IMF staff calcualtions.
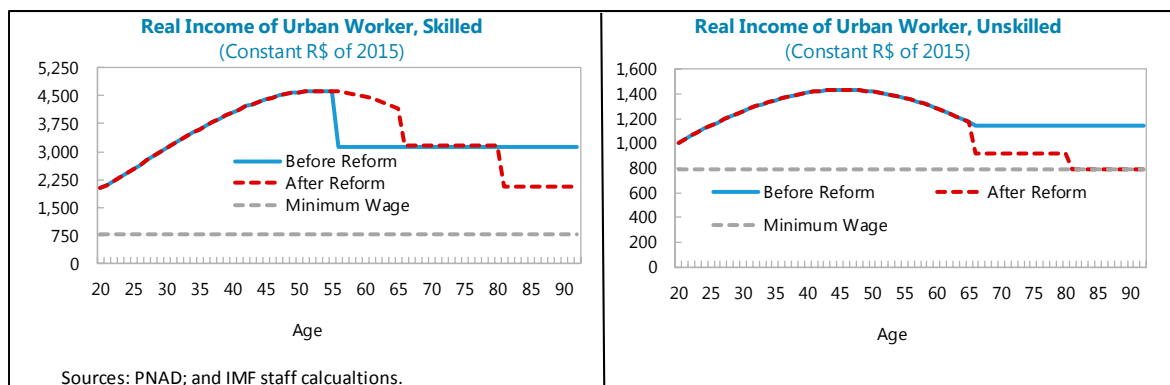
13.   The reform would not affect the rural workers' gross lifetime income. In the survey, the median rural worker's income is less than the minimum wage and about 45 percent of rural workers earn half the minimum wage (Appendix I, Figure 1). The rural worker's income increases after retirement to one minimum wage. Since in the current reform the retirement

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[7] Under the new rule, survivors' pensions are pro-rated to the size of the household; in the example, the sole survivor would get a pension equal to 60 percent of the original benefit. Under the new rules the survivor's pension can be cumulated with the spouses' own pension up to the amount of two minim wages. If this limit is exceeded, the survivor can choose which one of the benefits to keep. In our example the surviving spouse has no retirement benefit of her own, so this issue does not arise.

age would not change for these workers, the reform would not impact their gross income. Regarding their net income, the reform would have a small impact, to the extent they would be required to contribute up to 5 percent of the minimum wage for at least 15 years.

14.   Gross lifetime income of public sector workers would decrease. We assume that the median public worker retires at age 60 under the current rules, in line with the average observed for civil servants of the federal government—the group affected by the reform. After reform, the public worker would continue to work for another 5 years. The retirement benefit he receives would be lower, as in the case of private unskilled worker. The change in the net lifetime income would be more pronounced, however, as the public worker would be contributing to the social security system for a longer period (at an overall rate that is higher than in the private sector).

15.   From the perspective of the cumulative net transfers a person obtains from the system, the proposed social security reform will reduce most significantly the differences between public and private sector employees. The new rules governing minimum retirement age and benefit calculations will not only generate fiscal savings, they will reduce inequities in a social security system that currently benefit disproportionately a small share of the population already enjoying higher wages—the public employees. The chart below shows net cumulative transfers to each of the four types from the social security system, before and after the reform. This is the difference between all retirement and survivor benefits on the one hand, and all contributions paid by or on behalf of the employee, on the other hand. This comparison naturally involved the calculation of present discounted values, using a 1 percent real discount factor, in accordance with established OECD methodologies (Queisser and Whitehouse, 2006). The calculation shows that the PDV of net transfers will be lower after the reform for all four types of workers in the exercise; but the reduction will be greater for the public-sector worker and the private sector skilled worker.

Sources: PNAD; and IMF staff calcualtions.

Change in the Lifetime Income Post Reform
(Constant R$ of 2015, Thousands)

Sources: PNAD; and IMF staff clculations.
1/ Earnings minus taxes and social security contributions paid by the worker.

PDV of Net Government Transfers
(Constant R$ of 2015, Thousands)

Sources: PNAD; and IMF staff calculations.
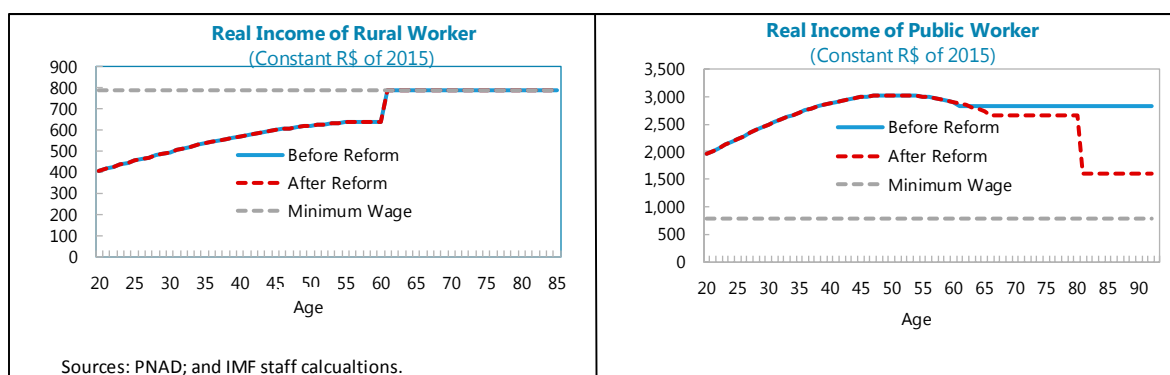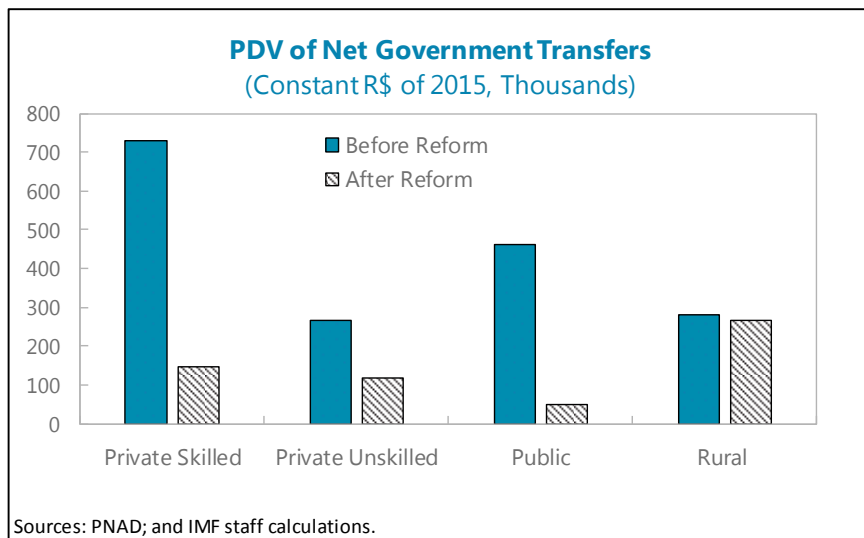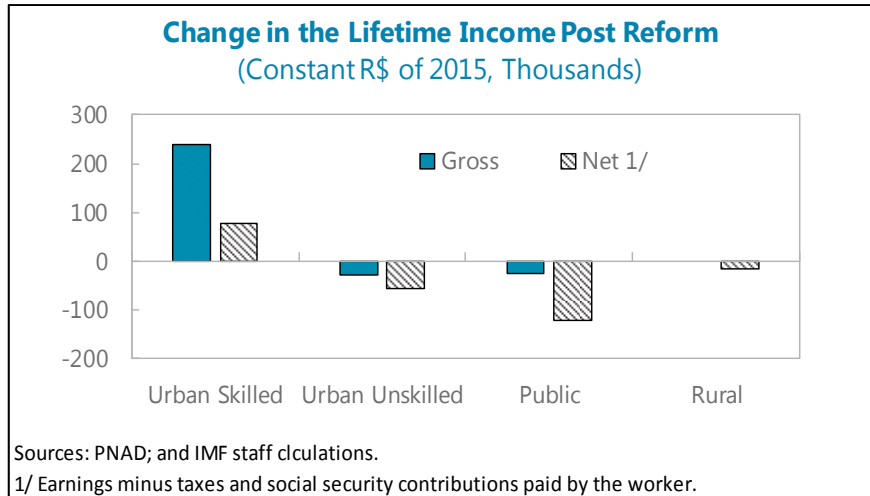
Appendix I. Figure and Table

Figure 1. Brazil: Distribution of Wages Among Rural and Unskilled Urban Workers 1/
(Percent)

Unskilled Urban Workers

Rural Workers
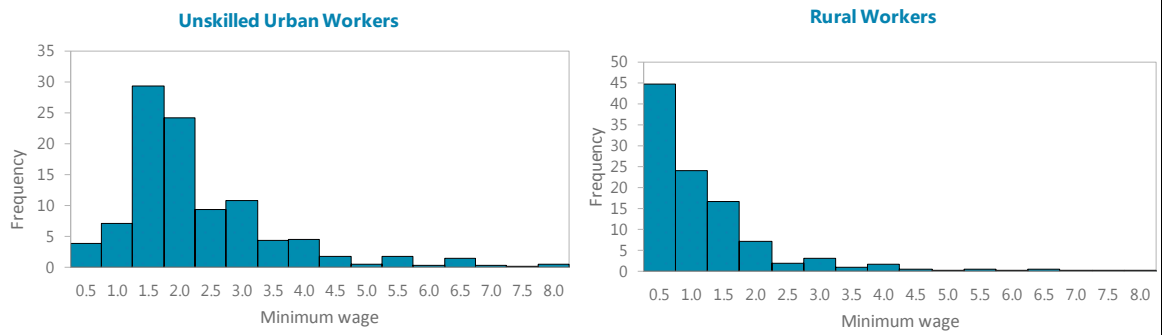
Sources: PNAD; and IMF staff calculations.

1/ To obtain the nominal wages the numbers in x-axis should be multiplied by the minimum wage.

Table 1. Brazil: Pension Parameters Pre- and Post-Reform

Pension Reform Elements			
	Before the Reform	**After the Reform**	**Transition**
RGPS			
Retirement by Contribution Time	Eligibility: (1) the sum of age and contribution time should be no less than 85/95 for women/men; or (2) minimum of 30/35 years of contribution for women/men. Benefit value: in (1) is equal to s: the average of the worker's 80% highest salaries; in(2) is equal to s*f , where f is the so-called "fator previdenciário" (which depends on time of contribution, on age and life expectancy at retirement).	Will be extinguished. There will only be retirement by age (see rules below).	Eligibility for the transition rule: (1) minimum age of 53/55 in 2017 for women/men. The minimum age will gradually increase reaching 62/65 years for women/men in 2036/2038; and (2) penalty linked to the time of contribution (30% of the contribution time left to achieve 30/35 years of contribution for women/men.)
Retirement by Age	Eligibility: minimum age of 60/65 years for women/men and minimum of 15 years of contribution time. Benefit value: is equal to s*(70% + 1% per year of contribution), where s is the average of the worker's 80% highest salaries. Contribution rate: employee = 8% to 11%; employer = 20%.	Eligibility: Minimum age of 62/65 years for women/men and minimum of 25 years of contribution time. Benefit value: is equal to $s'*(70\%x + 1.5\%y_1 + 2.0\%y_2 + 2.5\%y_3)$, where s' is still to be determined (meanwhile it will be the average of all salaries since 1994), y_1 is the number of contributing years within the 26 to 30 years range, y_2 is the number of contributing years within the 31 to 35 years range, and y_3 is the number of contributing years after 35 years of contribution. Benefit value cannot be higher than s. Contribution rate unchanged: employee = 8% to 11%; employer = 20%.	
RPPS			
Basic Retirement	Eligibility: Minimum age of 55/60 years for women/men and minimum of 30/35 years of contribution. Benefit value: 80% of highest salaries. In 2013 the RPPS salaries were capped for new entrants to a value approximately equal to 6 minimum wages. Contribution rate: employee = 11%; employer (government) = 22%.	Eligibility: Minimum age of 62/65 for women/men and 25 years of contribution time. Minimum age for teachers will be 60 years old. Benefit value: is equal to $s'*(70\%x + 1.5\%y_1 + 2.0\%y_2 + 2.5\%y_3)$, where s' is still to be determined (meanwhile it will be the average of all salaries since 1994), y_1 is the number of contributing years within the 26 to 30 years range, y_2 is the number of contributing years inside the 31 to 35 years range, and y_3 is the number of contributing years after 35 years of contribution time. Benefit value cannot be higher than s. Contribution rate unchanged: employee = 11%; employer (government) = 22%.	Eligibility for the transition rule: (1) minimum age of 55/60 in 2017 for women/men. The minimum age will gradually increase reaching 62/65 years for women/men in 2036/2038; and (2) pay a penalty in terms of time of contribution: the penalty equals to 30% of the contribution time left to achieve 30/35 years of contribution.

Table 1. Brazil: Pension Parameters Pre- and Post-Reform (Concluded)

Pension Reform Elements		
Before the Reform	**After the Reform**	**Transition**
Rural pensions		
Retirement by age Eligibility: Minimum age of 55/60 for women/men and at least 180 months in rural activity. Benefit value: Minimum wage. Contribution rate: in practice, no contribution is needed.	Eligibility: Minimum age of 57/60 for women/men. Benefit value: minimum wage. Contribution rate: at most 5% of the minimum wage for at least 15 years.	Women's minimum age will start increasing in 2020 to 56, and reach 57 in 2022. Remaining transition rules still to be determined.
Other Benefits		
BPC Eligibility: people older that 65 years old or with disabilities and per capita income less than 25%-50% of minimum wage. Benefit value: 1 minimum wage.	Eligibility: people older that 68 years old or with disabilities and per capita income less than an amount that still needs to be decided. Benefit value: 1 minimum wage	Minimum age will gradually increase starting from 2020, reaching 68 years in 2024.
Survivors' pensions Benefit value: 100% of the deceased's pension benefit.	Benefit value: 50% of the deceased's pension benefit + 10% for each dependent (up to the limit of 100%). Minimum benefit must be 1 minimum wage. This benefit can be accumulated with other pension up to 2 minimum wages. If the sum is larger than 2 minimum wages, the recipient needs to choose one of them.	

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INEQUALITY IN BRAZIL: A MICRO-DATA ANALYSIS[1]

In this study, we document the decline in inequality in Brazilian states in a new database constructed from micro data from the national households' survey. We find that labor income growth, formalization, and schooling contributed to the decline in inequality during 2004–14, but redistributive policies, such as Bolsa Família, have also played a positive role. Going forward, it will be important to phase out untargeted subsidies, such as public spending on tertiary education, and contain growth of public sector wages, to improve budgetary efficiency and protect gains in equality.

A. Overview

1. **Over the past decade or so, Brazil—a still highly unequal country—has been the poster child for social mobility.** According to the World Bank's international poverty line, Brazil slashed poverty from 25 percent of the population in 2004 to 8.5 percent in 2014. Extreme poverty declined from 12 to 4 percent over the same period.[2] As millions were lifted out of poverty, the middle class was boosted. The commonly used inequality measure – the World Bank's Gini coefficient (the closer to 1, the more unequal) – declined from 0.60 in 1990 to 0.51 in 2014. Inequality reduction was achieved thanks to a decade-long period of economic growth and deliberate income and social inclusion policies, such as minimum wage increases and targeted social programs. Yet, inequality remains high: based on data from the 2014 *Pesquisa National de Amostra de Domicílios* (PNAD), labor income of the population in the top decile of the income distribution corresponds to 40 percent of labor income of all Brazilian families, the top 1 per cent receives about 12 percent, and the top 0.1 per cent around 2.5 percent. Half percent of all labor income is concentrated in the top 0.01 percent.

2. **The recession that started in 2014 is likely to have affected the pace of progress on the social dimension.** Earnings from work continue to be the main source of income for the poorest, who are suffering disproportionately from job losses. Rising unemployment and compressed households' disposable incomes are affecting their living standards and jeopardizing social mobility. Indeed, unemployment reached 13 percent in 2017, but has been higher for lower-skilled labor.[3] But even after the recession ends, the government will face a long period of fiscal consolidation. To observe the cap on federal government non-interest expenditures, restraint will be necessary across all categories of spending in the medium term.

3. **In this paper, we construct a new database from disaggregated individual and households survey data from the annual PNAD and use it to study the evolution and the**

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[1] Prepared by Carlos Góes and Izabela Karpowicz (WHD).

[2] Households whose income is less than $3.10 a day/less than $1.90 for extreme poverty at constant 2011 PPP-adjusted U.S. dollars.

[3] By early-2017, more than one in four young adults in Brazil were unemployed.

drivers of inequality in Brazil. To our knowledge, we are the first to apply the methodological techniques from the literature on global income inequality spearheaded by Milanović and his co- authors, and recently updated in Lakner and Milanović (2015), to gain insights on both within- and between-state inequality in Brazil. Another novelty of our paper is the use of a spatial price differences index that we construct from PNAD data to allow comparability of nominal incomes across states with unequal living standards. Because of the nature of the data employed, we focus mainly on inequality of outcomes, and do not study inequality of opportunities, such as access to education and health services, clear water and sanitation, and quality infrastructure.

4.   **We find that the decline in overall inequality in Brazil was driven by both falling inequality within states and income convergence between states.** We look at the evolution of income and consumption patterns for specific income percentiles of the national income distribution over time and show that income convergence was more evident around the median of the distribution. From our regressions we find that most of the change in Gini can be explained by income growth, higher schooling levels and labor formalization, but the targeted social program, *Bolsa Família*, also contributed to income convergence. Civil servants' wage growth has, in contrast, slowed gains in equality. The reforms necessary to ensure fiscal sustainability should incorporate the objective of improving spending efficiency while avoiding adverse effects on income distribution. As labor formalization and income growth are slowing down, going forward, better targeting of social benefits, rationalizing the tax system, and moderating civil servants' wages will be key for preserving gains in equality.

5.   **The paper is organized as follows:** in Section B we describe the evolution of inequality in Brazilian states and regions over the past decade using a novel data set; in Section C we present a regression analysis to study the policy drivers of the decrease in inequality; and we conclude in Section D.

B.   Historical Trends in Regional Inequality 2004–14

6.   **In this section, we analyze the historical trends in inequality in Brazil based on the new database constructed using micro-data from the Brazilian households' survey (PNAD).** Because of the nature of the data we are using, we focus mainly on inequality outcomes, and do not study inequality of opportunities, such as access to health, clear water and sanitation, and quality infrastructure. We base our estimates of inequality on after-tax per capita income as reported in the PNAD, which includes data on labor income and retirement benefits but excludes information on other benefits, such as invalidity and survivors' pensions, and income from financial and real assets.

7.   **Growth in incomes over the past decade has allowed the poorer segments of the population to increase their consumption of durable goods.** With access to electricity being nearly universal across all income levels already in 2004, access to durable goods increased substantially for all households over the following 10 years (Figure 1). But how have overall incomes behaved and what is the state of income inequality today?

Figure 1. Brazil: Convergence in the Consumption of Goods by Households

(In percent of total households in that quantile of the distribution)
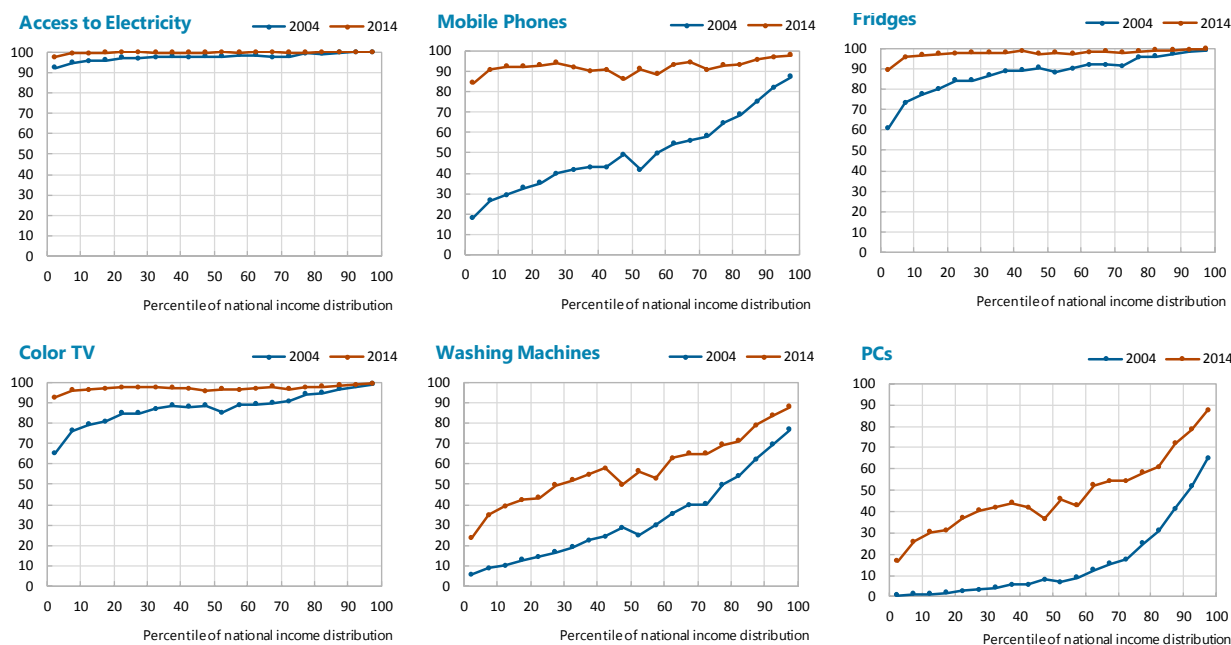
Source: PNAD; and IMF staff calculations.

8.   Income inequality in Brazil has declined. The Gini coefficient for Brazil published by the Brazilian Institute of Statistics (IBGE) fell from 0.54 in 2004 to 0.49 in 2014, and other commonly used inequality measures also show declining trends. We construct a Gini coefficient based on the income reported by individuals and households in the annual survey (PNAD) administered by the IBGE, adjusting households incomes for spatial prices differences throughout the country (Box 1). Our "adjusted" Gini index has declined at the level of the country form 0.55 to 0.50 over the same period. The usefulness of this adjusted income measure is in facilitating comparisons across states.

Brazil: Gini Index
(Index, 0= absolute equality)
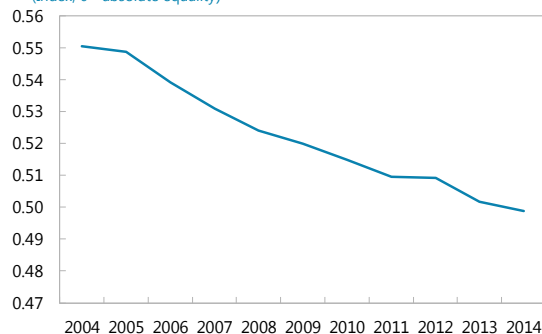
Sources: PNAD microdata; and IMF staff calculations.

Box 1. The Cost of Living Adjustment

Inequality measures must take into account differences in the cost of living across and also within countries to distinguish between nominal and real differences in incomes. Cross-country inequality studies, such as Lakner and Milanović (2015) or Dollar and others (2013) for instance, typically correct the between-country income statistics using PPP conversions, often based on national price indices. But adjusting for living standards is important also when studying inequality within large countries because, as highlighted by Deaton and Dupriez (2011), the Balassa-Samuelson effect may cause richer regions to show permanently higher price levels. Indeed, price levels are not homogeneous in Brazil. Góes and Matheson (2017) have documented large divergences of product-specific price dynamics, particularly for non-

Box 1. The Cost of Living Adjust (Concluded)

tradables, across different metropolitan areas. Almeida and Azzoni (2016) showed that overall level price differences in Brazilian metro areas can diverge with levels as low as -19 percent and as high as +14 percent from the national average.

Because micro-data for consumer-price level differences is not available in Brazil we use information on rental prices as a proxy. The consumer prices indices are available only for the 12 metropolitan areas, insufficient to capture the potentially ample differences in living costs across Brazilian states. Using data on declared households' rent prices from the PNAD and other characteristics of the dwelling (such as the number of rooms or area in square meters) we adjust households' incomes for spatial price differences in a two-step procedure. The advantage of using rental price data for the adjustment is that most of the price dispersion generally comes from non-traded goods, and especially housing. Li and Gibson (2014), for instance, have used data on dwelling sales in urban China to develop spatially-disaggregated indices of house prices which they used as spatial deflators for both provinces and core urban districts.

First, for each sub-region $k = [1,2,...,7]'$ of each state $s = [1,2,...,27]'$ and each year $t = [2004,...,2015]'$, we construct a *rental spatial price difference index*, which measures the percent deviation of the per room average rental price from the national average:

$$r_{s,k,t} = \frac{m_{s,k,t}/n_{s,k,t}}{m_t^*/n_t^*} - 1$$

where m is the average monthly rent price for the cluster s,k, while n is the average number of rooms per household for the cluster, and the * denotes national averages.

Given that overall spatial price differences can be well approximated by a linear function of housing spatial price differences, we use the parameter from Azzoni and Almeida (2016), assumed to be homogenous across regions, and our heterogeneous rental spatial-price difference index to fit an overall spatial price difference index $\hat{p}_{s,k,t} = \phi r_{s,k,t}$ Finally, we use $\hat{p}_{s,k,t}$ to obtain adjusted households incomes, which are then used in the analysis of income distributions and their trends.

Brazilian Metro-Areas: Correlation Between Overall and Housing Spatial Price Differences (In deviations from national averages)

y = 0.5557x - 0.0118
R² = 0.7245

Overall spatial price differences

Housing spatial price differences
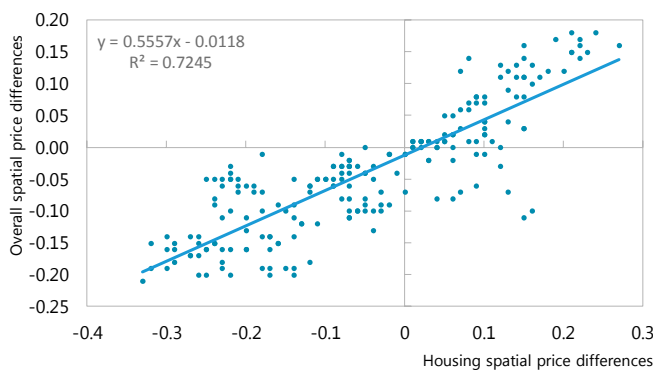
Sources: Almeida and Azzoni (2016); PNAD microdata; and IMF staff calculations.

Our estimates of the overall Gini coefficients are nearly perfectly correlated with the official estimates of the IBGE. Higher households income per capita regions tend to face price levels above the national average, while lower income regions tend to face price levels below the national average. Thus, adjusting for spatial price differences compresses nominal differences in incomes and decreases the overall inequality indicator. The estimated coefficient shown in the figure (less than one) denotes the compression effect of adjustment.

Brazil: National Gini Coefficient (2004-14)
(Index, 0 = absolute equality)

y = 0.9789x - 0.0108
R² = 0.9886

Authors' estimates

IBGE official estimates
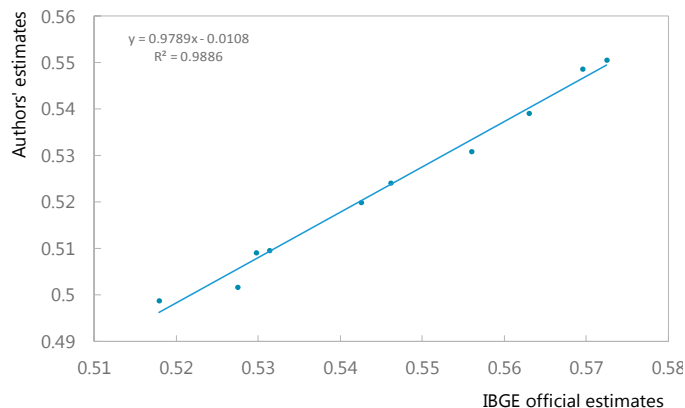
9.   The decline in inequality was pronounced in the period studied, including among regions. Within-state income distributions vary from state to state. In 2014, the Gini coefficient of the most unequal state was 18 percent higher than the national Gini ratio, whereas the Gini of the least unequal state was almost 20 percent lower than the national ratio. These differences are, however, narrower than in the past: the standard deviation of state Gini coefficients decline from 0.035 to 0.033. Between-states inequality has decreased as a share of total inequality as incomes grew faster in the poorer regions of the North, Northeast, and Midwest (blue, navy, and yellow lines below). Convergence in average incomes led to a decreasing share of total inequality explained by between-state inequality, as depicted also by the Generalized Entropy and Atkinson's indices.[4]

Figure 2. Brazil: Income Inequality in Brazilian States: A Dynamic Decade

Brazil: Relative Gini Coefficient, by State, 2014
(State Gini / National Gini ratio)

Sources: PNAD microdata; and IMF staff calculations.

Brazil: Gini Coefficient, by State, 2004–2014
(State-wide Gini coefficient)

Sources: PNAD microdata; and IMF staff calculations.

Brazil: Real Income Per Capita Growth, by Region and Quantile, 2004–2014
(Average real income growth per year; average across states per quantile; adjusted for spatial-price differences)

Sources: PNAD microdata; and IMF staff calculations.

Brazil: Trends in Between State Inequality
(Share of total inequality represented by differences between state averages)

Sources: PNAD microdata; and IMF staff calculations.

10.   Inequality within states also dropped. This was driven primarily by substantially higher income growth rates for lower-income households in nearly all states. Inequality has declined relatively more in the states with higher initial inequality in 2004, especially after excluding the outliers (SC and DF), which illustrates convergence in within-state inequality indices across the country.

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[4] The Generalized Entropy (GE) and Atkinson (A) indices, used as consistency checks, are perfectly decomposable into within and between components.

Figure 3. Brazil: Income Inequality in Brazilian States: Some Evidence of Convergence

Brazil: Distribution of Within-State Gini Coefficients (2004-14)
(Index; 0 = perfect equality)
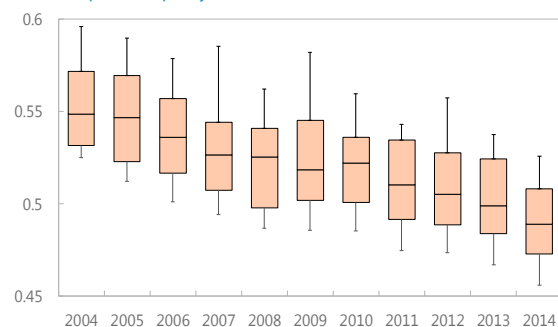
Sources: Staff estimates with PNAD microdata. Box show interquartile range, whiskers show 10th/90th percentiles.

Brazilian states: Evidence for Convergence in Within-State Income Inequality
(State Gini in 2004 and Percent Change in Gini Coefficient 2004–14)
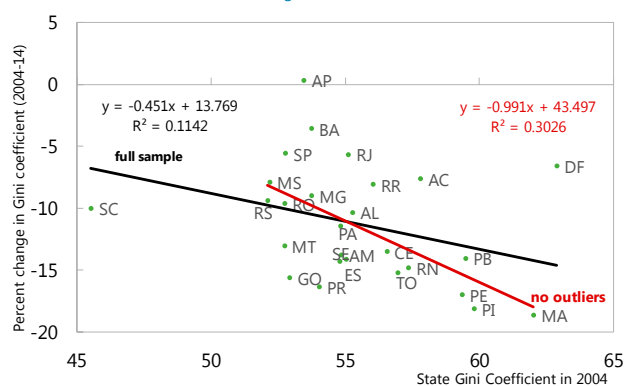
Sources: PNAD microdata; and IMF staff calculations.

11.   While convergence across states is most evident in the lower and upper quantiles of the income distribution, some catch-up occurred also in the middle of the distribution. In the figures below we explore how within-state income distributions fit into the national income distribution.[5] Households belonging to the lowest and those belonging to the highest deciles of the state income distribution also belong to the lowest/highest deciles of the national distribution. In other words, the living standards of the lowest-earning and those of the highest-earning are similar across states and regions. However, depending on the state, the state median household income can fall anywhere between the 30th and the 70th percentile of the national distribution. These differences have shrunk over time, as shown by a more pronounced downward shift of the curve

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[5] The different colors in Figure 4 represent households' income per capita distributions of states that belong to the region. For a legend of states see Appendix I.

depicting the standard deviation of percentiles between the states and the national income distribution around the 30th to 70th percentiles since 2004.

Figure 4. Brazil: Income Inequality in Brazilian States – Disaggregated

Brazil: Household Income per Capita Distribution, by State, 2004
(Percentiles of state-wide and nation-wide household income distribution, PPP adjusted)

Sources: PNAD microdata; and IMF staff calculations.

Brazil: Household Income per Capita Distribution, by State, 2014
(Percentiles of state-wide and nation-wide household income distribution, PPP adjusted)

Sources: PNAD microdata; and IMF staff calculations.

Figure 5. Brazil: Income Inequality in Brazilian States – Convergence in the Middle

Sources: PNAD microdata; and IMF staff calculations.

Sources: PNAD microdata; and IMF staff calculations.

12.   There is no evidence of reversal of progress with equality in the most recent PNAD (2015). With the drop in employed population, real gross households earnings contracted in 2015 across all professions and for the first time in 11 years. The real income decline touched the entire income distribution, but, as it was more severe in the higher income brackets, inequality fell slightly. The official Gini index calculated for all income sources fell from 0.497 in 2014 to 0.491 in 2015. The Gini calculated for labor income fell from 0.490 to 0.485 and, in the case of household income, from 0.494 to 0.493.

13.   However, the continuation of the recession through 2016 may have dented equality gains. Earnings from work represent a higher share of total income in the survey and a higher share of the income of households in the lowest 25th percentile. As job destruction continued through 2016, and inflation remained high, the relatively poorer households have suffered more. Preliminary 2016 inequality estimates from *FGV Social* suggest that inequality widened slightly for the first time in 22 years. The World Bank (2017) has estimated that the number of poor in Brazil will likely increase by 2.5–3.6 million by 2017, while the Gini index will increase from 0.51 to 0.52–0.54. Among the "new poor", young, skilled workers in the service sector will represent the higher share of those falling below the poverty line due to the crisis.

C.   Macro-Policies and Inequality Outcomes: Regression Analysis

Rapid labor formalization has contributed to boosting living standards of the poor and so have higher real wages and transfers. Redistributive taxation and social programs have also played a role in the decline in inequality.

Tax policy

14.   If achieved through progressive taxation, increases in tax revenues can be correlated with declining inequality. Brazil's overall tax system relies relatively more on indirect taxes, which

are regressive.[6] Effective personal income tax (PIT) rates, which take into account all the admissible deductions (green line in the chart), do not seem progressive either. However, taking into account the taxation of dividends at corporate level the system's progressivity appears to be restored (red line). Applying standard benefit-tax incidence analysis, Lustig and others (2014) find that personal income taxes in Brazil are progressive and redistributive, and contributed to reducing the Gini of after-tax incomes by 1.9 percent in 2009.

Minimum wage and expenditure policies

15.   Supported by strong growth, *the **minimum wage** policy in Brazil has sustained upward social mobility for lower classes*. The effect of the minimum wage policy on inequality is ambiguous, given its potentially offsetting impact on employment and inflation (Jaumotte and Osorio Buitron, 2015). According to Maurizio (2014), increases in the minimum wage in Brazil led to wage compression, which helped to reduce inequality among wage earners. Indeed, the hourly wage for a worker with a given level of education rose much faster among the poor than for the rest of the population in the last decade mainly because of the minimum wage policy. This occurred as the increase in the real minimum wage above productivity was accompanied by a decline in the unemployment rate supported by Brazil's relatively strong output growth during the period. However, in an environment of low or negative growth, such as the one facing Brazil recently, the minimum wage growth may be affecting employment negatively, with the effect being more pronounced for the unskilled workers (IMF, 2015). This would in turn lead to higher before tax (or *gross)* inequality.

16.   Public sector wage increases systematically above private sector wage growth appear to have slowed equality gains. While it is not uncommon to find evidence of public sector wage markups in the literature (Clements and others, 2010), the wage *premia* on public sector jobs in Brazil are particularly high. In 2014, the estimated median premium on public sector jobs across comparable professions was about 50 percent up to the secondary education level (Box 2). To the extent that public sector workers' incomes are higher that private sector workers', stronger growth of wages in the public sector may have moderated equality gains achieved in the recent decade.

Brazil: Change in Real Annual Earnings, per Sector
(Accumulated change in real earnings, per sector, in percent)
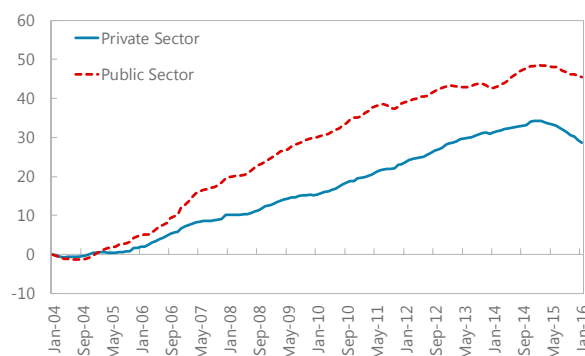
Sources: PME/IBGE.

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[6] The ratio of direct to indirect taxes at the general government level was 45 percent in 2016. Brazil relies on indirect taxes more than other Latin American economies and significantly more than OECD countries (OECD, 2010). According to Amaral and others (2016), the average Brazilian worker pays 15 percent of his gross income in income taxes, 3 percent in asset taxes, and 24 percent in consumption taxes. Those making up to R$3,000 per month pay 24 percent of their gross income in consumption taxes, while those making more than 10,000 pay 17 percent in consumption taxes. While personal income taxes are progressive, excessive reliance on consumption taxes makes the overall system regressive.

17. ***Bolsa Família*** **is Brazil's flagship social assistance program for reducing poverty.** Beneficiary coverage has increased from about 6.5 million households in 2004, when it was founded, to over 14 million in 2014 (56 million people). Budgetary appropriations for the program have also increased from about 0.3 percent of GDP to 0.6 percent of GDP over the same period. The World Bank (2017) estimates that 58 percent of the decline in extreme poverty in Brazil over 2004–14 was due to *Bolsa Família* transfers. Soares and other (2006) report that in 2005 about 80 percent of the *Bolsa Família* budget went to families below the poverty line (half of the minimum wage per capita) and that the program was responsible for 21 percent of the decline in the Gini coefficient between 1995 and 2005.

Brazil: Fiscal Cost and Reach of *Bolsa Família*
(Percent of GDP and millions of households)
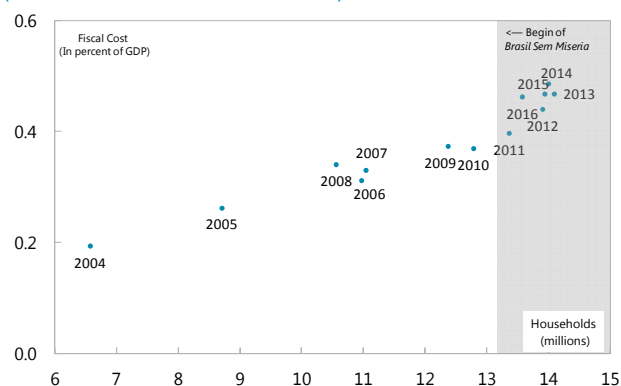
Sources: Ministry of Social Development; and IMF staff calculations.

Box 2. Returns to Education and Public-Private Wage Gap

We estimate the returns on education in Brazil by means of two "Mincer" regressions (Mincer, 1974) with identical specifications that relate the log of wages to years of schooling and experience for the public and the private sector separately, for each period $t = [2004, \dots, 2015]^{'}$. The model contains more than 50 other controls:

$$\ln(w_{i,t}) = \alpha_t\, s_{i,t} + \beta_{1,t} e_{i,t} + \beta_{2,t} e_{i,t}^2 + \gamma_t m_{i,t} + \sum_{n=1}^{4} \delta_{n,t} r_{i,n,t} + \sum_{n=1}^{13} \zeta_{n,t} o_{i,n,t} + \sum_{n=1}^{13} \theta_{n,t} a_{i,n,t} + \sum_{n=1}^{10} \phi_{n,t} c_{i,n,t} + \sum_{n=1}^{27} \psi_{n,t} d_{i,n,t} + \epsilon_{i,t}$$

where $w_{i,t}$ is the monthly wage for person i at period t; $s_{i,t}$ is the years of formal schooling; $e_{i,t}$ is the years of experience (defined as the individual's age minus years of schooling minus 6—the age when mandatory education starts); $m_{i,t}$ is a gender dummy; $r_{i,n,t}$ are dummies for races; $o_{i,n,t}$ are dummies for occupations (formal/informal worker, military, civil servant, domestic worker, self-employed, etc.); $a_{i,n,t}$ are dummies for sectoral economic activities (agriculture, industry, manufacturing, construction, commerce, etc.); $c_{i,n,t}$ are dummies for worker's class (director, middle management, administrative, sales, etc.); $d_{i,n,t}$ are dummies for the Brazilian states; and $\epsilon_{i,t}$ is the error term.

In the second step, we use the estimated coefficients from the regressions to generate two vectors of fitted values for each one of the ~150 thousand workers in the sample who belong to either the private or the public sector. The fitted values show the expected log wages for individuals, given the same set of observable characteristics.

Box 2. Returns to Education and Public-Private Wage Gap (Concluded)

We find that predicted earnings are an increasing function of the years of schooling in Brazil for public as well as private sector jobs, but earnings among those in public sector jobs are consistently higher, in line with Souza and Medeiros (2012). Up to the secondary education level, the 25 percent lowest predicted earnings in the public sector are higher that the median earnings in the private sector.

We define the public sector wage premium as the difference between the two predicted values $p_{i,t} = \ln(\hat{w}^{public}_{i,t}) - \ln(\hat{w}^{private}_{i,t})$.[1] Like Braga and others (2009), we find some signs of compression of the premium at higher educational levels. However, we find the premium to be high across all years of schooling, which was not the case ten years ago, when they published their study.

Given their observable characteristics, at least 75 percent of workers would benefit today by moving from the private to the public sector in comparable jobs at all education levels.

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[1] We ran Mincer regressions with the same controls for a sample of ~150,000 observations, calculated predicted values from coefficients resulting from the private and public sectors. Standard errors are from a bootstrap simulation with 500 repetitions.

Brazil: Predicted Returns on Schooling, 2014
(In log of monthly wages given years of formal education; distribution of predicted wages given 50+ controls for geography, demographics, experience, education, industry, management level, etc.)
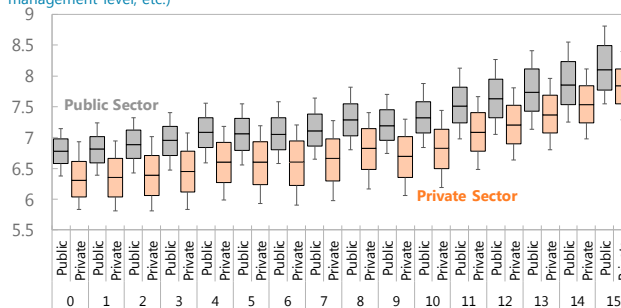
Sources: PNAD microdata; and IMF staff calculations. Boxes show interquartile range. Whiskers show 10th/90th percentiles. We ran Mincerian regressions with the same controls for a sample of ~150,000 obs, calculated predicted values from coefficients resulting from the private and public sectors, and ploted the distributions.

Brazil: Civil Servants Median Wage Premia, 2014
(In percent difference over predicted private sector wages)
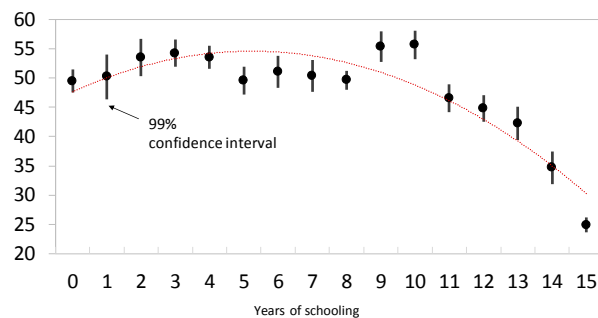
Sources: PNAD microdata; and IMF staff calculations.

18.   Even when they don't worsen income inequality by themselves, implicit *education subsidies* use up resources that could be otherwise employed to improve income equality. While spending on education may be concomitantly pro-growth and pro-equality (Ostry and others, 2014), it can be also seen as a blanket subsidy and weakly targeted transfers generally constitute an inefficient use of scarce resources. In Brazil, public universities are tuition-free. They are also more accessible to children of wealthier parents, who often have studied in private primary and secondary schools (World Bank, 2016). Indeed, nearly half of the public university student population in the PNAD survey belongs to households in the top quartile of the income distribution, while only 9 percent of university students come from families in the bottom quartile (see Box 3). This type of implicit subsidy benefits the rich disproportionally. Equality of opportunities could be enhanced by redistributing resources away from tertiary education towards improving provision of early childhood and primary schooling which would improve overall spending progressivity (IMF, 2014).

Box 3. An Example of Poorly Targeted Transfers: Public Universities

Over the past decades, the educational level of Brazilians improved significantly. The share of population between 20 and 22 years old that completed at least secondary education increased from 45.5 percent in 2004 to 60.8 percent in 2014, according to data from the PNAD. The improvement was widespread across regions, as depicted by the curves shifting to the right in the figure. At the same time, Brazil has expanded access to tuition—free, tax payer-funded public universities. Between 2000 and 2014 the number of students in public universities more than doubled—from 0.89 million to 1.96 million (Ministry of Education, INEP, 2015).

Brazil: Share of Population With Secondary Education
(Distribution of Brazilian municipalities according to share of population with at least secondary education)

Sources: IMF staff calculations with census data compiled by UNDP.

Students from better-off households are overrepresented in public universities. Nearly half of the public university student population in the sample belongs to households in the top quartile of the income distribution, while only 9 percent of university students comes from the bottom quartile. Meanwhile, about 40 percent of the younger cohorts of the Brazilian population still fails to complete secondary education.

We provide a more robust proof of the relationship between income and access to public universities by as in Góes and Duque (2016). We estimate a logit model with PNAD data to obtain the

Brazil: Overrepresentation of Top Quartile in Public Universities, 2014
(Share of overall population and public unversity population which belong to each quartile of household income per capita)

Sources: PNAD microdata; and IMF staff calculations.

probability of being public university student for individuals between 17 and 24 years old conditional on household's income per capita and a set of controls:

$$\Pr(y_i = 1 \mid f_i, X_i) = \frac{e^{\phi f_i + X_i' \gamma}}{1 + e^{\phi f_i + X_i' \gamma}}, \qquad y_i \in \{0,1\}$$

where y_i is a categorical variable denoting a student currently in a public university for individual i, f_i is household family income per capita and X_i' is a set of individual controls—which include age, gender, race and regional dummies (see Appendix I, Table 3).

We find that, even after controlling for geographic and demographic characteristics, students from richer households are considerably more likely to attend public universities. In fact, a student in the 25th percentile of the income distribution has a 2 percent probability of attending a public university while the one in the 99th percentile has more than 30 percent probability of attending it.

Brazil: Probability of Attending Public University and Household 1/ Income, 2014 (In percent, by household income per capita)
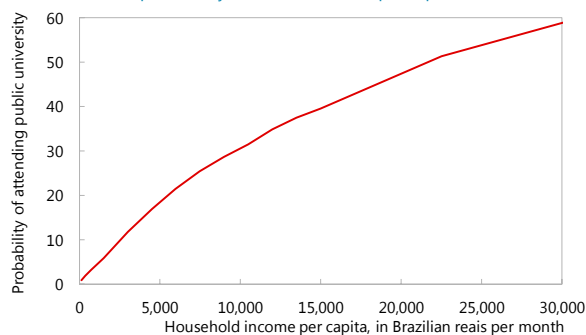
Sources: PNAD microdata; and IMF staff calculations.
1/ Average predicted values from multivariate logit regression for different income cohorts.

This finding is consistent with the intuitive diagnostic that children with richer parents, who can afford to study in private primary and secondary schools, obtain easier access to publicly-funded universities (World Bank, 2016).

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Box 3. An Example of Poorly Targeted Transfers: Public Universities (Concluded)

Redirecting government spending from tertiary to primary and secondary education would improve overall welfare and equality. Funding a student at the higher education level costs about four times as much as funding a student at the secondary education level in Brazil. This ratio is much higher than the OECD average of 150 percent (OECD, 2014). Given that many Brazilians do not complete secondary education and the rate of return to investment in human capital tends to be higher at lower levels of education (Heckman, 2008), targeting education spending on the poor and cutting subsidies to the rich can generate fiscal savings while making the access to education fairer, and ultimately equality of opportunities better.

</div>

19.   Below we present the results from the analysis of the drivers of changes in inequality in a regression framework. We use our data set constructed from the PNAD by aggregating individual data into state-level statistics.[7] We complement the state-level data with information on annual *Bolsa Família* state budgets and federal income tax revenues collected in states.[8] We use a two-stage least squares approach with state dummies to control for time-invariant state-specific characteristics. First, we regress the income of the top and bottom quartiles on the average income, civil servants' income, tax revenues, the share of formal sector workers in total, employment, schooling, and the per capita *Bolsa Família* budget for each state. We have two regressions in the first stage because the independent variables of interest can have different effects on different points of the income distribution—e.g., the average income growth rate can have a stronger impact on the bottom quartile than the top quartile growth rates. We then regress the Gini coefficient on the predicted values from the two first stage regressions. This allows us to pin down both the *marginal* impact (through the different quartiles) as well as the *net* impact of the first stage variables on the Gini coefficient (see Appendix II for more detail).[9]

Results from Stage II regression

Brazil: Decomposition of HH Income Inequality Dynamics (2004–14)
(In Gini Points)

Source: PNAD; and IMF staff calculations.

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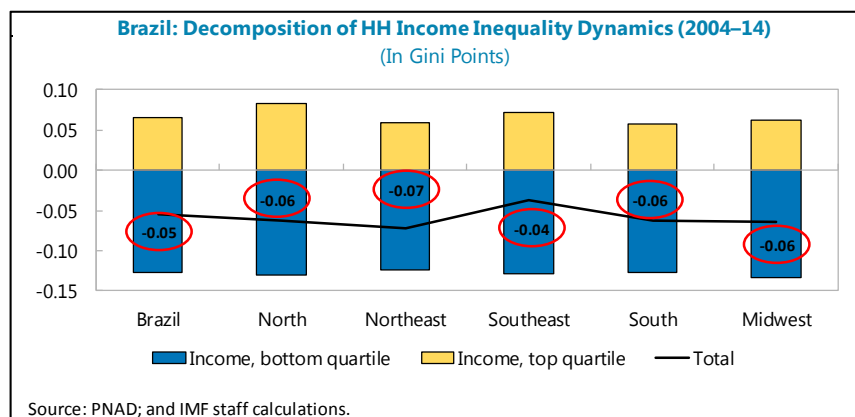
[7] See Appendix 2 for more details on the data sources and the construction of variables.

[8] We use the per capita income for the household as reported in the survey which includes data on labor income and retirement benefits but excludes information on other benefits, such as invalidity and survivors' pensions, and income from financial assets.

[9] Following this procedure takes care of potential endogeneity problem in the second stage regression.

20.   We find that employment, labor formalization, income growth, *Bolsa Família* budgets and schooling have contributed to declining inequality. The variables in the regression (Table 1) are mostly significant and bear the expected sign. Together, increased schooling and labor formalization explain the largest share of the decline in the Gini, but growth of average incomes and *Bolsa Família* also contributed to lowering inequality.[10] In contrast, the growth of incomes of civil servants has affected equality negatively. Income taxes are not a significant determinant of inequality, possibly because the PNAD may be underestimating the income of the top 1 percent of the population (see below).

Table 1. Brazil: Coefficients from the 2SLS Procedure

Coefficients from the 2nd Stage Regression

LN of average HH income per capita, bottom quartile (1)	-0.186	***	(1)
LN of average HH income per capita, top quartile (2)	0.198	***	(2)
constant	-0.057		

Marginal Effects on Gini from the 1st stage specification 1/		(1)	(2)
LN of average HH income per capita	-0.014	***	***
LN of Civil Servant HH income per capita	0.054	***	***
Share of Civil Servants, pct.	-0.001		
LN of Bolsa Familia exp. per capita	-0.007	***	***
Share of Formal Workers, pct.	-0.002		***
Employment Rate, pct.	-0.001	***	
Avg Schooling Years for Adults, bottom quartile	-0.030	***	
Avg Schooling Years for Adults, top quartile	0.004		
Tax Revenues, pct	0.003		

1/ The asterisks denote significance at the first stage in relation to first stage dependent variables (1) or (2). The coefficients shown here are the combination of 1st and 2nd stage regression coefficients.

Sources: PNAD; Receita Federal; Ministério de Desenvolvimento Social; IMF staff calculations.

21.   Potential data limitations must be kept in mind when interpreting results from our study. It is important to note that in the PNAD income received by the population in the top 1 percent of the income distribution in Brazil may be underreported (Souza, 2013). If income of the richest segment of the population not captured in the PNAD has increased over time, we could overestimate the decline in inequality in the country. In a recent study by Medeiros and others (2015), the authors combine data from the personal income tax returns (DIRPF) in Brazil with the PNAD and conclude that a growing share of income was received by the top 1 percent between 2006 and 2012 which has caused overall inequality to stagnate over that period. However, such adjustment was not possible in our study as the DIRPF data is not available for the entire period under consideration. Implicit in our approach is also the assumption that estimated parameters are homogeneous and linear across states. This is a limitation by construction which implies that extrapolating results from our estimates to draw conclusions for the future or for specific states must be done cautiously.

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[10] The findings on *Bolsa Família* are in line with previous literature in Brazil which underlines the redistributive power of the program (Neri, 2010; Azzoni and Silveira-Neto, 2012).

D. Conclusions

22.   In this study, we find evidence of a decline in inequality in Brazil, both between as well as within its 27 states from 2004 to 2014, and document the drivers of this phenomenon. Falling inequality can be attributed to convergence in households' incomes in the proximity of the mid-point of the state-wide distribution, which was stronger in more unequal states. We find that growth in incomes and labor formalization all contributed to declining inequality, but faster wage growth in the public sector played the opposite role. In terms of redistribution policies, *Bolsa Família* budgets were progressive, and so were higher schooling levels among the poor.

23.   Against a backdrop of a recession that is eroding incomes of the poor, the policy framework will need to strike a balance between the goals of fiscal sustainability and income equality. The sharp recession has brought to the fore important reform priorities, such as social security, labor market and tax reforms, some of which are already at an advanced stage. Preserving equality gains and moving forward with the inclusiveness agenda will remain key for gathering support for these reforms. This can be achieved without further increases in spending, by moderating civil servants' wage growth and using direct instruments to provide benefits based on need (IMF, 2014), such as *Bolsa Família*. Improved access to education and educational attainment for lower-income families can be achieved by redirecting resources currently funding universal, tuition-free access to tertiary education, while continuing to support university students based on need. The tax system can rely more on direct taxation and less on indirect taxes. Finally, the minimum wage policy should provide appropriate remuneration for the poor without discouraging formal employment.

Appendix I. Data and Sources

Legend – States

Decline in Inequality in States 2004–15
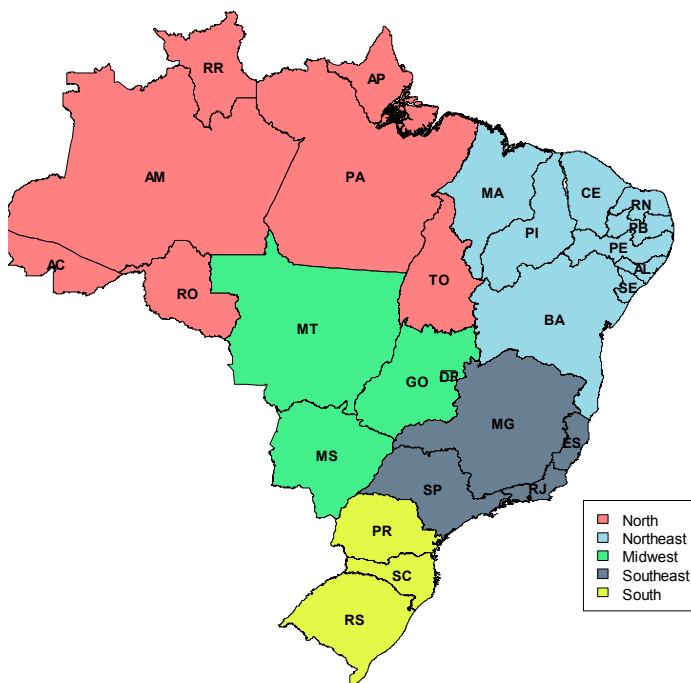
Region	Acronym	State
	AC	Acre
	AM	Amazonas
	AP	Amapá
North	PA	Paraná
	RO	Rondônia
	RR	Roraima
	TO	Tocantins
	AL	Alagoas
	BA	Bahia
	CE	Ceará
	MA	Maranhão
Northeast	PB	Paraíba
	PE	Pernambuco
	PI	Piauí
	RN	Rio Grande do Norte
	SE	Sergipe
	ES	Espírito Santo
Southeast	MG	Minas Gerais
	RJ	Rio de Janeiro
	SP	São Paulo
	PR	Paraná
South	SC	Santa Catarina
	RS	Rio Grande do Sul
	MS	Mato Grosso do Sul
Midwest	MT	Mato Grosso
	GO	Goiás
	DF	Distrito Federal
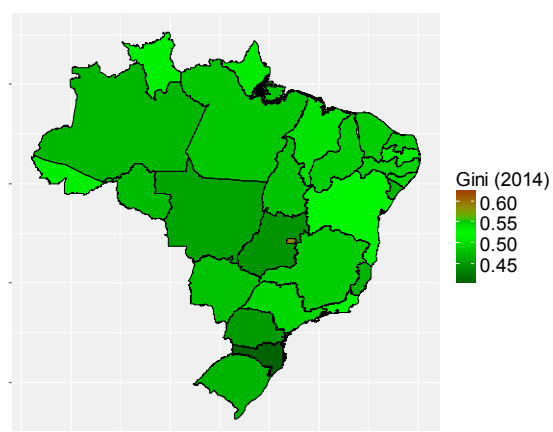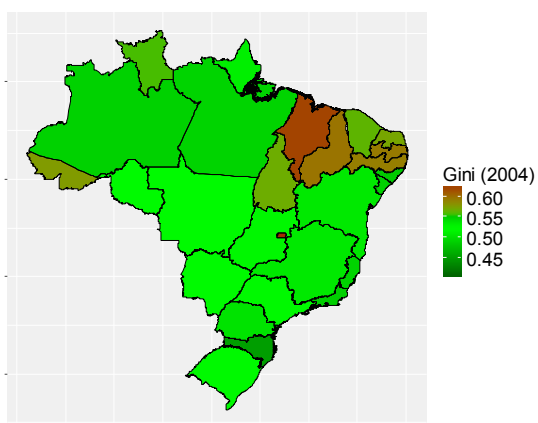
Sources: PNAD, and IMF staff calculations.

A. Data Sources and Definition of Variables used in the Regression

The Households Survey—PNAD

Most of our data consists of a novel dataset constructed by the authors from PNAD microdata. PNAD (*Pesquisa Nacional por Amostra de Domicílios*) is a National Household Survey conducted on a yearly basis. It collects data on nearly 360,000 individuals distributed through about 140,000 households. In total, to build time series for each state between 2004–15, we used around 6 million data points.

The PNAD has two annual datasets. The first one presents collective characteristics of each household while the second one has specific characteristics of each individual. We incorporated the complex survey design of PNAD by using the weights that the survey provides for the relative representativeness of each household/individual and adjusting our estimates and reported errors by double clustering at the state and household levels.

Using the household database, we constructed household income per capita quantiles for states and assessed the dynamics of household characteristics, including consumption patterns, for each quantile. We also constructed time series, for each state, of inequality indices (Gini, General Entropy and Atkinson), based on household income per capita.

Using the individual database, we constructed time series, for each state, for the following indicators: average household income per capita; average wage per active worker; share of formal workers in total population; average years of schooling for adult population (above 16); share of population between 17 and 30 years old in private universities; share of population between 17 and 30 years old in public universities, per capita *Bolsa Família* budget.

Definition of Variables used in the Baseline Regression

- Data on *Bolsa Família* budgets by state comes from the Brazilian Ministry of Social Development. We used these data to calculate the yearly real per capita outlays. The variable **Bolsa Família** was constructed by dividing the total *Bolsa Família* state budget by the state population after adjusting for spatial price differences and inflation. The indicator adjusted for spatial price differences.

- The **tax revenue** variable is constructed the federal personal and corporate income tax revenues collected by the states and reported by Receita Federal, divided by the state GDP from IBGE.

- Approximately between 40 and 80 percent of workers are "informal" in the dataset, depending on the state in which they reside. The **formal work** variable was constructed from the answers in the PNAD and expressed as the share of formal workers in total for each state:

- ▪ "formal worker"
  - Formal contract (*carteira assinada*);
  - Military;
  - Civil servant;
  - Employer/entrepreneur;
  - Domestic employee with a formal contract (*doméstico com carteira assinada*);
  - Unpaid/Voluntary work (*não remunerado*);
  - Self-employed as a manager/director;
  - Self-employed as an artist.
- ▪ "informal worker"
  - No formal contract (*sem carteira assinada*);
  - Domestic with no formal contract (*doméstico sem carteira assinada*);
  - Self-employed (except for manager/director and artist);
  - Self-consumption worker in production;
  - Self-consumption worker in construction.

- The **employment rate** variable is expressed as the share of persons who were working in the reference week in the total labor force (persons economically active, i.e. employed or actively looking for job).

- The **average income** variable is the average household per capita income for the state aggregated from the household income indicator available in the survey and adjusted for spatial price differences.

- The **civil servant income** is equal to the household income per capita for households whose reference person (respondent) is a civil servant. The indicator is adjusted for spatial price differences.

- The **schooling** variables is the average number of years of schooling for persons in the lower and top quartiles of the national household income per capita distribution.

Figure 1. Brazil: Household Income Per Capita Distribution, 2014
(Percentiles of state and national income distributions, adjusted for spatial price differences)
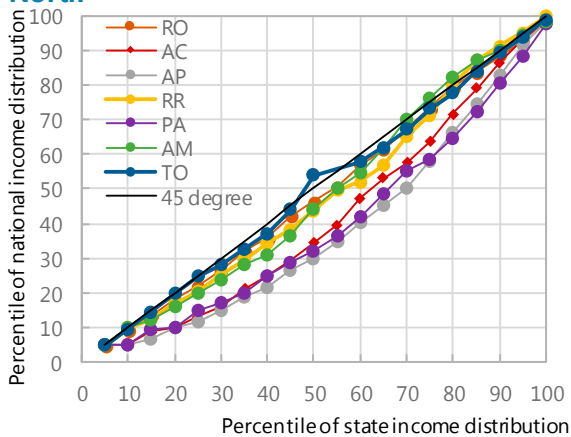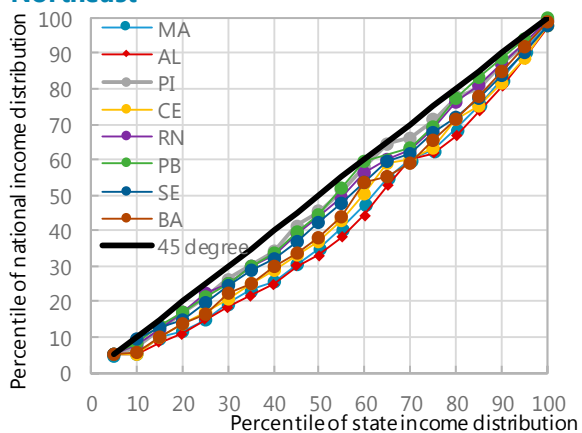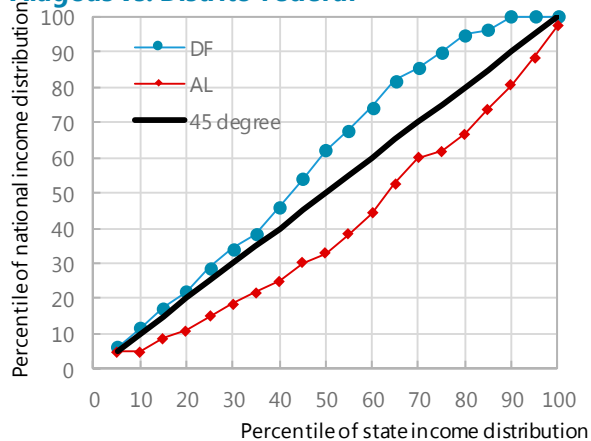
Source: PNAD microdata; and IMF staff calculations.

Table 1. Brazil: Percentile of National Per Capita Income Distribution for Percentile of State-Wide Per Capita Income Distribution, 2014

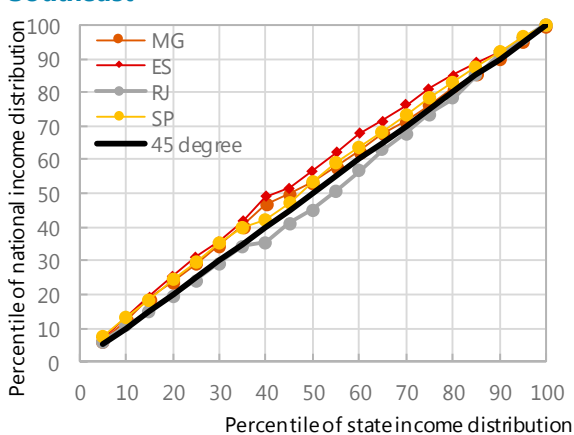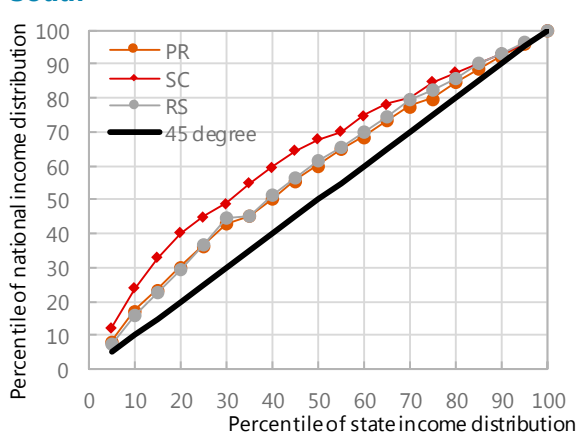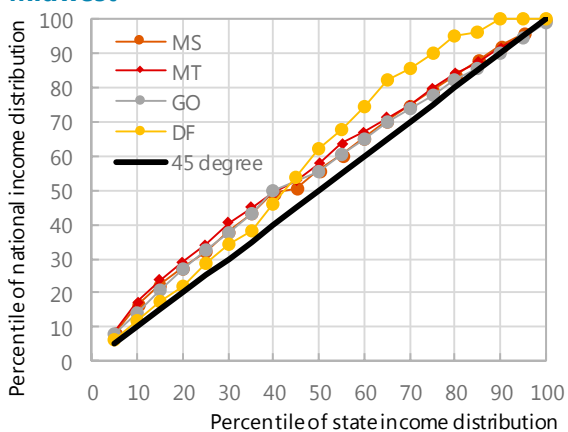| Percentile of state-wide income per capita distribution	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
RO	5.0	9.4	13.5	18.3	22.0	26.3	31.9	35.7	42.2	46.3	50.6	56.9	61.3	67.5	73.1	79.4	83.6	88.5	92.7	98.5
AC	5.0	5.0	8.7	10.0	13.1	15.8	21.3	25.0	29.2	34.5	39.7	47.4	53.2	57.4	63.6	71.5	79.0	86.3	93.2	98.9
AP	5.0	5.0	6.5	10.0	11.7	15.0	19.1	21.4	26.5	30.0	34.8	40.0	45.0	50.2	58.0	66.3	74.7	82.9	91.4	98.2
RR	5.0	9.9	12.4	17.2	20.3	25.0	29.8	34.3	38.3	43.8	49.6	51.9	56.7	65.3	71.2	78.8	86.6	91.0	95.0	99.7
PA	5.0	5.0	9.4	10.0	14.4	17.0	20.0	24.8	28.4	32.2	36.4	41.9	48.8	55.0	58.4	64.2	72.1	80.5	88.2	97.3
AM	5.0	10.0	12.1	16.3	20.0	23.9	28.0	30.9	36.3	43.9	50.0	54.8	61.8	70.0	76.1	82.4	87.3	90.0	94.3	98.1
TO	5.0	9.7	14.6	19.9	24.8	28.0	32.6	37.1	44.0	53.8	n.a	57.8	61.9	67.3	73.2	77.7	83.9	89.1	93.6	98.8
MA	5.0	5.2	10.0	11.8	15.0	19.7	23.4	25.8	30.7	35.0	40.6	47.3	54.9	60.0	62.7	68.6	75.3	82.6	90.6	98.1
PI	5.0	7.1	11.6	16.6	21.2	26.2	30.0	34.2	41.4	45.5	51.2	58.0	64.5	66.1	71.2	77.7	80.5	87.3	92.8	98.8
CE	5.0	5.0	9.6	13.1	16.4	20.2	25.0	29.0	32.6	36.7	42.5	49.6	58.7	60.0	62.9	71.0	75.0	81.3	88.5	97.5
RN	5.0	7.9	12.3	16.9	22.2	25.0	30.0	33.2	38.9	44.0	49.5	56.5	60.0	63.0	68.5	76.5	81.0	86.8	93.1	99.3
PB	5.0	8.6	13.3	17.1	21.1	25.0	30.0	33.7	39.4	44.7	51.8	59.5	n.a	63.4	69.3	77.4	83.2	88.9	94.3	99.9
PE	5.0	6.1	10.0	12.0	15.6	20.0	24.4	28.3	32.2	37.0	42.6	49.3	51.8	56.7	62.9	70.3	75.4	82.1	89.5	98.0
AL	5.0	5.0	8.6	10.9	15.0	18.4	21.6	25.0	30.0	33.0	38.2	44.3	52.7	59.9	61.8	66.8	73.8	80.6	88.5	97.4
SE	5.0	9.6	12.6	15.0	19.6	24.7	29.0	32.1	36.9	42.3	47.5	53.8	59.6	61.8	67.6	71.8	77.6	83.9	90.0	97.7
BA	5.0	5.7	10.0	13.6	16.7	22.2	25.0	29.7	33.6	38.2	44.0	53.6	55.0	59.1	65.3	71.5	77.8	84.9	91.8	98.7
MG	6.4	12.4	18.8	23.8	29.4	34.9	40.9	48.7	50.0	53.5	58.3	62.7	68.1	71.8	76.7	81.2	85.7	90.1	95.1	100.0
ES	7.1	13.0	19.2	25.4	31.3	35.6	41.7	49.0	51.7	56.7	62.1	67.7	71.4	76.3	81.2	85.0	88.8	92.2	96.0	100.0
RJ	6.0	10.6	15.0	19.5	24.1	29.2	34.3	35.4	41.2	45.0	50.9	56.7	62.9	67.7	73.2	78.3	85.0	91.2	95.9	100.0
SP	7.2	13.5	18.3	24.7	29.6	35.1	40.0	42.1	46.9	53.5	58.9	63.6	68.0	73.2	78.3	82.9	87.4	91.7	95.9	100.0
PR	8.4	17.4	23.5	30.4	36.6	43.0	45.4	50.2	55.5	60.2	65.0	68.7	73.1	77.2	80.0	84.8	88.5	92.1	96.0	100.0
SC	12.4	24.0	32.8	40.3	45.0	48.8	55.0	59.7	64.5	67.9	70.1	75.0	78.3	80.0	84.7	87.4	90.0	93.1	95.9	100.0
RS	7.3	15.8	22.5	29.5	36.7	44.2	45.0	51.4	56.2	61.7	65.0	70.0	74.6	79.3	82.2	85.4	90.0	93.2	96.6	100.0
MS	8.1	16.5	22.4	27.4	32.0	37.9	43.2	49.2	50.5	55.8	60.2	65.2	70.3	75.0	79.4	83.6	87.9	92.2	95.9	100.0
MT	8.4	17.4	23.7	29.0	34.0	40.4	45.0	49.3	52.8	57.9	63.6	67.0	71.3	75.0	80.0	84.0	87.6	91.6	95.0	99.6
GO	7.9	14.1	20.8	27.1	32.5	37.8	43.3	49.6	n.a	55.3	60.3	65.2	70.0	73.7	77.9	82.2	85.5	90.0	94.4	99.1
DF	6.3	11.7	17.4	21.9	28.9	34.3	38.2	46.1	54.0	62.1	67.9	74.2	82.0	85.5	90.0	94.9	96.4	100.0	100.0	100.0
Range (Max - Min)	2	5	6	8	9	9	10	10	10	11	10	10	9	9	8	7	6	5	3	1

Sources: PNAD microdata; and IMF staff calculations.

Table 2. Brazil: Drivers of Income Inequality in Brazil's States from the 2SLS Regression (2004–14)

1st Stage Least Squares Results

LN of average HH income per capita, bottom quartile (1)	Coeff.	Std. Err	z	P>|z|	95% Conf Interval	
LN of average HH income per capita	0.734	0.061	12.040	0.000	0.614	0.853
LN of Civil Servant HH income per capita	-0.135	0.040	-3.380	0.001	-0.213	-0.057
Share of Civil Servants, pct.	-0.002	0.004	-0.570	0.569	-0.010	0.005
LN of Bolsa Familia exp. per capita	0.134	0.021	6.480	0.000	0.093	0.174
Share of Formal Workers, pct.	0.002	0.002	1.210	0.227	-0.001	0.006
Employment Rate, pct.	0.005	0.003	2.060	0.039	0.000	0.011
Avg Schooling Years for Adults, top quartile	0.156	0.019	8.280	0.000	0.119	0.193
Avg Schooling Years for Adults, bottom quartile	-0.007	0.011	-0.620	0.533	-0.028	0.015
Tax Revenues, pct	-0.013	0.009	-1.450	0.146	-0.031	0.005

LN of average HH income per capita, top quartile (2)	Coeff.	Std. Err	z	P>|z|	95% Conf Interval	
LN of average HH income per capita	0.618	0.056	11.130	0.000	0.510	0.727
LN of Civil Servant HH income per capita	0.145	0.036	3.990	0.000	0.074	0.216
Share of Civil Servants, pct.	-0.005	0.004	-1.350	0.176	-0.012	0.002
LN of Bolsa Familia exp. per capita	0.090	0.019	4.780	0.000	0.053	0.127
Share of Formal Workers, pct.	-0.010	0.002	-5.890	0.000	-0.013	-0.006
Employment Rate, pct.	0.001	0.002	0.210	0.832	-0.004	0.005
Avg Schooling Years for Adults, top quartile	-0.003	0.017	-0.200	0.842	-0.037	0.030
Avg Schooling Years for Adults, bottom quartile	0.015	0.010	1.490	0.137	-0.005	0.034
Tax Revenues, pct	0.003	0.008	0.380	0.707	-0.013	0.019

Sources: PNAD; Secretaria da Receita Federal; Previdência Social; and IMF staff calculations.

Table 3. Brazil: Logistic Regression: Determinants of Attending Public University, 2014 1/

Marginal Effects on Probability of Attending Public University		
	(1)	(2)
LN of HH income per capita	0.025***	0.022***
	(0.001)	(0.001)
Age		0.001***
		(0.000)
Male		-0.004***
		(0.001)
Black		-0.014***
		(0.003)
Brown		-0.013***
		(0.002)
Asian		0.016**
		(0.007)
Native Brazilian		-0.024*
		(0.013)
North Dummy		0.021***
		(0.002)
Northeast Dummy		0.021***
		(0.001)
South Dummy		-0.000
		(0.002)
Midwest Dummy		0.013***
		(0.002)
Pseudo-R2	0.0716	0.0953
Observations	40,385	40,385

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Sources: PNAD microdata; and IMF staff calculations.
1/ Coefficients denote the expected marginal response in the dependent variable after a unit change in the independent variable at specific points. Continuous variables (age and income) have been calibrated such that coefficients denote the marginal responses at their respective medians. Categorical variables (gender, race, and state dummies) have been calibrated to zero and the coefficients denote the marginal responses after a change from zero to one in the categorical variable. Households' income per capita was adjusted for spatial price differences.

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INTEREST RATES AND INFLATION IN BRAZIL[1]

The conventional view among economists is that higher interest rates reduce inflation. However, the prolonged period of low inflation and low interest rates in advanced economies following the global financial crisis appears to be inconsistent with this view. This sparked a debate: Do lower interest rates increase inflation (the conventional view), or do they lead to lower inflation (the so-called Neo-Fisherian view)? This chapter finds strong evidence in favor of the conventional view of monetary policy transmission in Brazil. While lower inflation and lower nominal interest rates can be achieved over the long term by targeting a lower level of inflation, this is likely to come at the cost of lower output (and employment) in the short term—a cost that can be mitigated by enhancing monetary policy transparency and credibility. Monetary policy transmission could be made more efficient by reducing distortions and improving the allocation of resources in the financial sector.

A. Introduction

1.   **The conventional view among economists is that *higher* interest rates led to l*ower* inflation.** The rationale behind this view is that higher interest rates increase the cost of borrowing and dampen demand across the economy, resulting in excess supply and lower inflation. In this context, there is several channels through which higher interest rates reduce inflation, including the exchange rate channel, the credit channel, and the bank-balance sheet channel (see Mishkin, 1996). Here, a central bank facing the prospect of inflation being higher than its inflation target would raise interest rates enough to increase the real (inflation-adjusted) cost of borrowing, reducing aggregate demand and returning inflation back toward the desired level.

2.   **There has recently been some debate about whether *lower* inflation can be achieved by setting *lower* policy interest rates, the so-called Neo-Fisherian effect.** At the heart of the debate, is a well-known equation in economics, the Fisher equation, which relates the nominal interest rate R_t to the real interest rate r_t and expected inflation $E_t\pi_{t+1}$ (all annualized):

$$R_t = r_t + E_t\pi_{t+1}$$

Taken at face value, and assuming that the real interest rate is fixed in the long run, the equation implies that a lower long-run inflation rate can be achieved by permanently setting the nominal interest rate to a lower level (see Cochrane, 2016). Indeed, proponents of this view often point to the positive relationship between nominal interest rates and inflation seen across many countries as evidence of 'Neo-Fisherian' effects (see Figure 1).[2]

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[1] Prepared by Troy Matheson (WHD).

[2] Neo-Fisherian effects exist in standard models used by central banks under the assumption that economic agents have perfect foresight and do not base their decisions on the past observations. See Garcia-Schmidt and Woodford (2015) and Garin and others (2016).

Figure 1. Brazil: Headline Inflation and Policy Rate

Source: Haver Analytics.
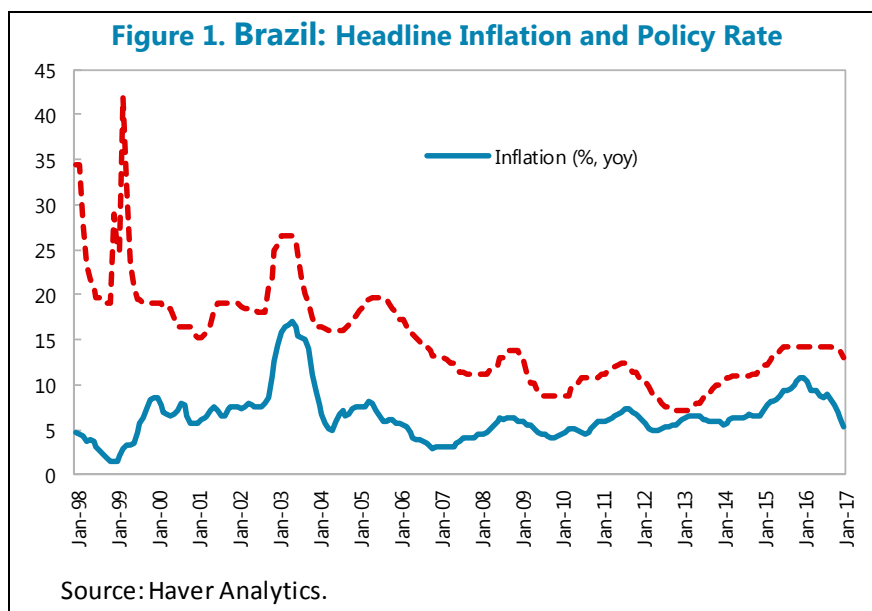
3.   Would a commitment to fix the policy interest rate to a lower level eventually lead to lower inflation? To answer this question, an empirical analysis is conducted to assess the impact of changes in Brazil's policy rate on inflation in Section B. Section C then evaluates a simple model with long-run Neo-Fisherian effects in the context of several countries' historical experiences in transitioning to lower levels of inflation. Section D concludes with a summary of key findings and policy conclusions.

B.   Empirical Analysis

4.   The empirical analysis is based on Vector-Auto-Regressions (VARs). The baseline VAR is estimated using monthly data ranging from 2003 to 2016 and contains six variables: monthly headline inflation, the nominal interest rate (SELIC), the output gap, 12-month-ahead inflation expectations, and monthly percent changes of commodity prices and the real-effective exchange rate. Inflation responses to the interest rate are likely to different across different sectors of the economy, so in addition to the baseline VAR, five additional VARs are estimated as a robustness check, where each VAR includes inflation for a different sector of the economy. Overall, the empirical analysis examines the impact of policy interest rate changes on headline inflation, non-regulated-price inflation, regulated-price inflation, service-price inflation, tradable inflation, and non-tradable inflation.[3]

5.   Cross-correlations show that *higher* inflation leads to *higher* interest rates and *higher* interest rates lead to *lower* inflation, consistent with the conventional view. The estimated cross-correlation function from the baseline VAR is displayed in Figure 2; the results for all inflation rates can be found in Appendix I, Section B. There is a statistically significant positive relationship

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[3] VAR lag lengths are selected using the Swartz-Bayesian Inflation Criteria. Parameter uncertainty is captured in the analysis using bootstrapping methods, where for each VAR is resampled 1000 times.

between past levels of inflation and the interest rate and a statistically significant negative relationship between past levels of the interest rate and inflation. These results broadly reflect the standard view of the monetary policy transmission to inflation. Since inflation tends to lead the policy interest rate, it appears that the central bank has responded to inflation developments over this sample, partly as the result of unanticipated demand and supply shocks (such as food and regulated-price shocks, and exchange rate shocks). The results also suggest a peak correlation between leads and lags of inflation and leads and lags of the interest rate of around 6 months.

Figure 2. Brazil: Correlation: Headline Inflation and Interest Rate
(Correlation and 20th to 80th percentiles)
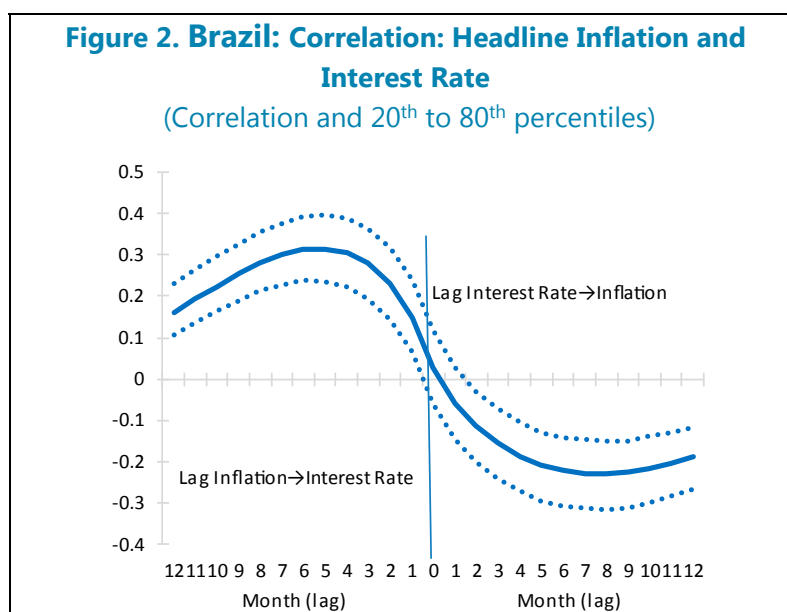
6. **Structural VARs also support the conventional view that an unexpected cut in the policy interest rate increases inflation in the short term.** Responses of headline inflation to a 100 basis point cut in the policy interest are displayed in Figure 3; the results for all other inflation rates can be found in Appendix I, Section B. Here, the uncertainty around the responses relates both to uncertainty about the parameters of the VARs and to the recursive ordering used to identify the monetary policy shock.[4] Examining all possible recursive identification schemes allows the analysis to be agnostic about whether an interest rate shock has a contemporaneous or a lagged impact on inflation. The results show that an unexpected cut in the policy interest rate tends to increase inflation over time, with the magnitude of the impact depending on the sector of the economy and the peak impact generally occurs around 9 months after the shock. The short-term impact of a lower interest rate on inflation is less clear cut, with identification schemes that allow for a cut in the interest rate to immediately impact on inflation (within the same month) sometimes suggesting a positive relationship between inflation and interest rate shocks. Overall, however, the results from the structural VARs strongly support the standard view of monetary policy transmission.

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[4] Each VAR contains six variables so there is 720 different ways to order the variables to identify shocks: 69 of these orderings lead to unique inflation responses to an interest rate shock. 1,000 parameterizations of each reduced-form model are simulated using bootstrapping methods, leading to 69,000 different estimates of the response of inflation to an interest rate for each VAR examined.

Figure 3. Brazil: Headline Inflation after 100bps Cut in Policy Rate (Percent, annualized, 20th and 80th percentiles)

Months

Source: Fund staff estimates.
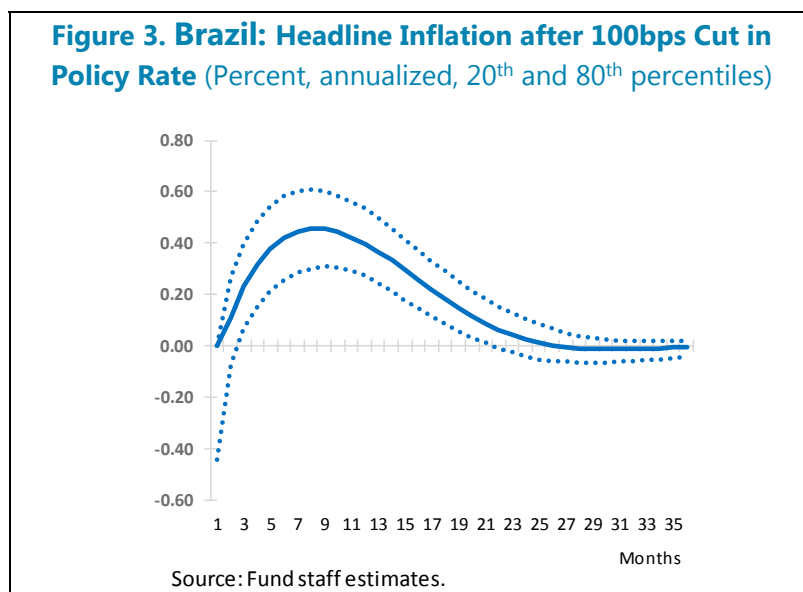
C.   How can Lower Inflation Be Achieved over the Long Term?

7.   While there is little evidence that a lower interest rate leads to lower inflation in Brazil in the short term, the long-run Fisher equation can still help to inform policy advice. The long-run Fisher equation is:

$$R^* = r^* + \pi^*$$

where the steady-state nominal interest rate is equal to the steady state real interest rate plus the inflation target. Assuming the long-run neutrality of money (i.e. nominal variables do not affect real variables in the long run), the inflation target determines the steady state nominal interest rate. This relationship can easily be inserted into a simple (and standard) New Keynesian model (see Appendix I, Section C).

8.   Model-based simulations show that a lower long-term inflation and nominal interest rates can be achieved by lowering the inflation target, but this is likely to be costly in the short run when the central bank has limited policy credibility. The results show that a reduction in the inflation target reduces both the nominal interest rate and inflation in the long run (Figure 4). If households and firms in the economy have expectations that are either partially forward-looking or entirely backward looking, the transition to the new inflation target requires lower output in order to move inflation expectations to the new target; the real interest rate must rise to reduce demand in the short term. On the other hand, in a purely forward-looking model the central bank is fully credible, and households and firms fully understand the future implications of monetary policy actions and immediately embed this knowledge in their expectations. In this case, the transition of inflation and nominal interest rates to the new target is instantaneous once the target is announced and output is unaffected.

Figure 4. Brazil: Simulated Responses to a Change in the Inflation Target from 4.5 Percent to 2 Percent

Source: Fund staff estimates.
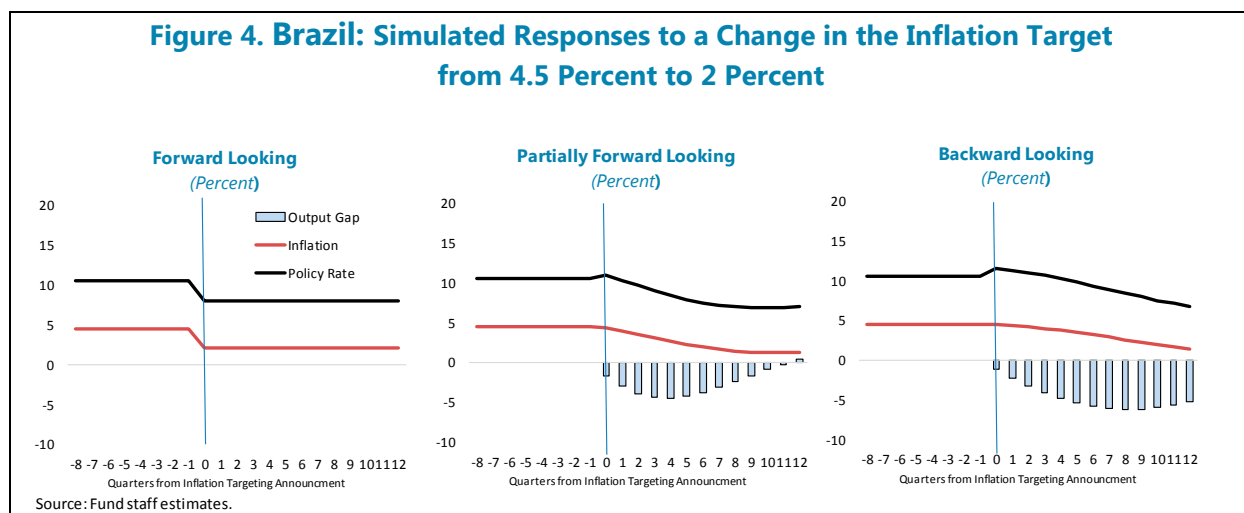
9.   Disinflation episodes across countries show that inflation was slow to adjust to lower levels and the transition to lower inflation was costly in terms of output, reflecting unanchored inflation expectations and limited monetary policy credibility prior to disinflation. Figure 5 shows the behavior of inflation, interest rates, and the output gap in the two years prior to the adoption of inflation targeting in the first five countries that formally adopted the practice, in addition to the Volker disinflation episode in the United States, beginning in 1981.[5] The behavior of inflation, interest rates, and the output gap follow broadly similar trends across countries. Nominal interest and inflation rates were positively correlated and tended to decline together once the central bank formally adopted inflation targeting; output gaps generally moved into negative territory. These results are qualitatively (and quantitatively) very similar to the simulation results when households' and firms' expectations for inflation and output are not assumed to be entirely forward looking. The large output losses during disinflation across these countries likely reflects a high degree of inflation persistence and limited policy credibility prior to the adoption of inflation targeting. Changing the inflation target would be likely be less costly if the central bank had more policy credibility and more anchored inflation expectations prior to the target change.

D.   Summary and Discussion

10.   There is strong evidence of the conventional view of monetary policy transmission in Brazil, suggesting that a cut in the policy interest rate leads to higher inflation in the short term. Cross correlations show that higher inflation leads to higher nominal interest rates and higher interest rates result in a reduction in inflation. Since inflation tends to lead the policy interest rate the sample examined, it appears that the central bank has responded to inflation developments, partly as the result of unanticipated demand and supply shocks (such as food and regulated-price shocks, and exchange rate shocks). Structural VARs also suggest that an unexpected cut in the policy

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[5] For each country, the output gap is defined as the percent deviation of real GDP from a linear trend.

interest rate leads to a broad-based rise in inflation across the sectors examined, with the peak impact on inflation occurring around 9 months after a monetary policy shock.

Figure 5. Brazil: Disinflation Episodes Across Countries

United States
(Percent, annual average)

Quarters from Volker Disinflation (1981)

New Zealand
(Percent, annual average)

Quarters from Inflation Targeting Announcment

Canada
(Percent, annual average)

Quarters from Inflation Targeting Announcment

Australia
(Percent, annual average)

Quarters from Inflation Targeting Announcment

United Kingdom
(Percent, annual average)

Quarters from Inflation Targeting Announcment

Sweden
(Percent, annual average)

Quarters from Inflation Targeting Announcment

Legend: Output Gap, Interest Rate, Inflation

Source: Fund staff estimates.

11.   Model-based simulations and cross-country evidence suggest that lower inflation and lower nominal interest rates can be achieved over the longer term if the central bank commits to a lower inflation target. If households and firms base their output and inflation expectations on the past (even partially), the transition to the new inflation target comes at the cost of lower output in the short term, with larger output losses and more prolonged transition periods occurring when expectations are more backward looking. An examination of disinflation episodes across several countries broadly supports the key findings from model simulations that assume that expectations were (at least) partially backward looking prior to disinflation.

12.   While it appears there is no easy way to permanently lower inflation in Brazil, a lower inflation target could be achieved at less cost with enhanced monetary policy transparency and credibility. Enhanced credibility can better anchor inflation expectations, reduce the persistence of inflation, improve the short run tradeoff between inflation and output, and mitigate the cost associated should a lower inflation target be desired over the medium term. As discussed in Domit and others (2016), there are several dimensions along which Brazil's inflation targeting framework can be improved to enhance transparency and credibility, including increasing the autonomy of the central bank and changing the inflation target from a range that needs to be met at the end of each year to a longer-term point target. The National Monetary Council made a step in this direction in 2015 by narrowing the target range from 4.5 percent +/- 2 percent to 4.5 percent +/- 1.5 percent from 2017.

13.   Monetary policy transmission could also be made more efficient by reducing distortions and improving resource allocation in the financial sector. There is general agreement that the effectiveness of monetary policy in Brazil could be improved by changing various credit policies that involve earmarking and credit subsidies. In particular, as already proposed by the authorities, the gap between the subsidized interest rate on long-term lending (the TJLP) and the policy interest rate (the SELIC) could be reduced over time to improve monetary policy transmission. Linking the TJLP more tightly with the SELIC or another market-determined interest rate (such as long-term yields on government inflation-linked debt) would enhance the transmission of SELIC changes to longer-term interest rates. This could increase the potency of a given change in the SELIC and contribute to lower interest rate volatility over the business cycle. Improving the efficiency of resource allocation in the financial sector could also contribute to a lower long-term real interest rate in Brazil, allowing for lower nominal interest rates for a given inflation target.[6]

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[6] See Minutes of the 205th Meeting of the Monetary Policy Committee ("Copom") of the Central Bank of Brazil for a discussion.

Appendix I. Data and Robustness

A. Data

<table>
<tr><td colspan="3" align="center">**Data, Sources and Transforms**</td></tr>
<tr><td>**Series**</td><td>**Source**</td><td>**Transform***</td></tr>
<tr><td>Headline IPCA</td><td>IBGE</td><td>Δlog(x)*1200</td></tr>
<tr><td>Non-tradable IPCA</td><td>IBGE</td><td>Δlog(x)*1200</td></tr>
<tr><td>Tradable IPCA</td><td>IBGE</td><td>Δlog(x)*1200</td></tr>
<tr><td>Services IPCA</td><td>IBGE</td><td>Δlog(x)*1200</td></tr>
<tr><td>Non-regulated IPCA</td><td>IBGE</td><td>Δlog(x)*1200</td></tr>
<tr><td>Regulated IPCA</td><td>IBGE</td><td>Δlog(x)*1200</td></tr>
<tr><td>Inflation expectations (12-months ahead)</td><td>BCB</td><td>x</td></tr>
<tr><td>Interest rate (SELIC)</td><td>BCB</td><td>x-hptrend(x)</td></tr>
<tr><td>Activity Index (IBC-BR)</td><td>BCB</td><td>log(x)*100-hptrend(log(x))*100</td></tr>
<tr><td>Commodity Price Index (IC-BR)</td><td>BCB</td><td>Δlog(x)*1200</td></tr>
<tr><td>Real Effective Exchange Rate (broad)</td><td>JP Morgan</td><td>Δlog(x)*1200</td></tr>
<tr><td colspan="3">* Δ=first difference; hptrend=Hodrick-Prescott Filter</td></tr>
</table>

B. Empirical Results

Figure 1. **Brazil:** Range of Cross-Correlations Between the Interest and Inflation Rates
(Median and 20th and 80th percentiles)

Headline and Interest Rate
(Correlation)

Non-Regulated and Interest Rate
(Correlation)

Regulated and Interest Rate
(Correlation)

Services and Interest Rate
(Correlation)

Tradable and Interest Rate
(Correlation)

Tradable and Interest Rate
(Correlation)

Source: Fund staff estimates.
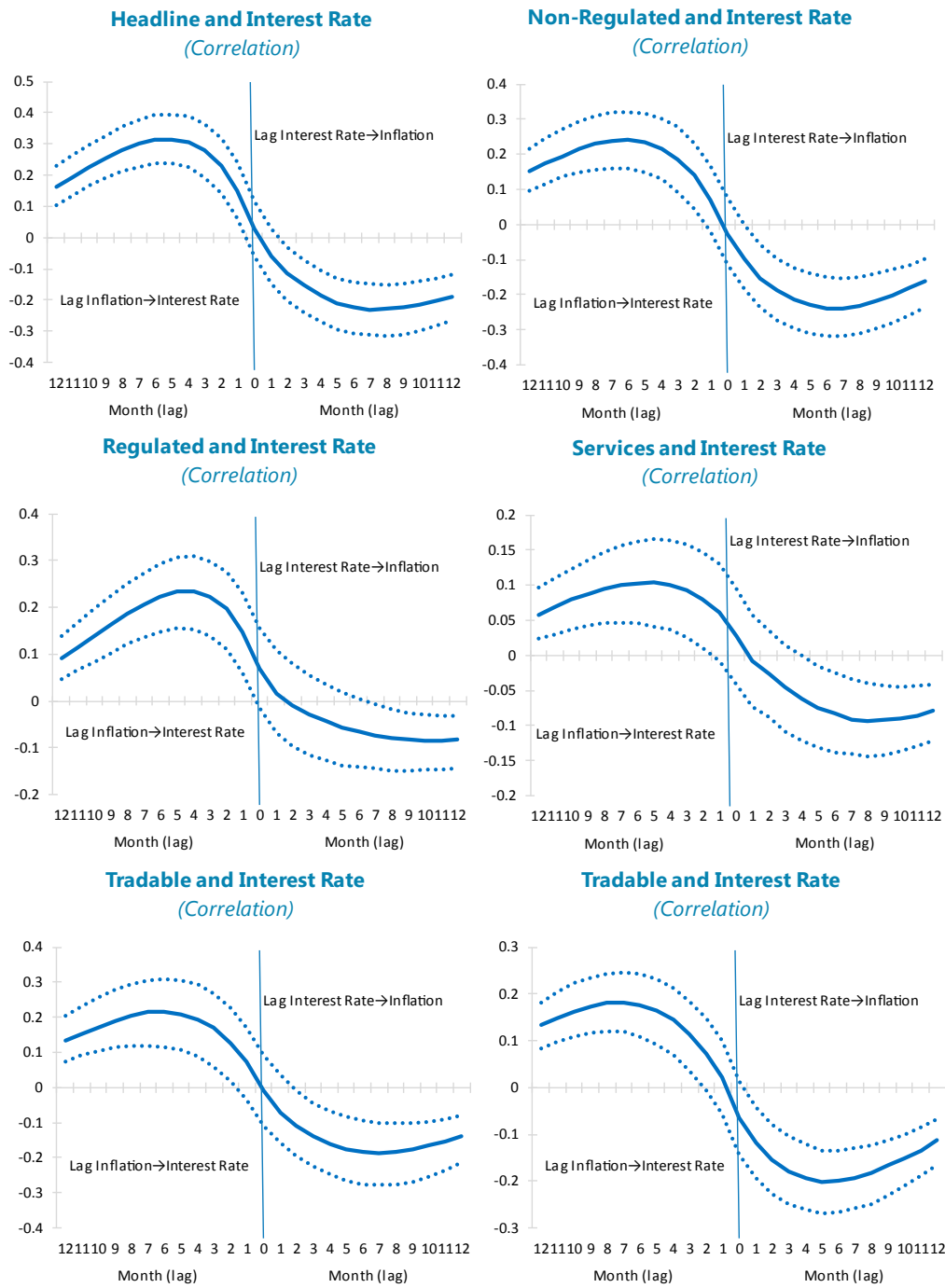
Figure 2. Brazil: Range of Inflation Responses to 100bps Increase in Interest Rate
(Median and 20th and 80th percentiles)
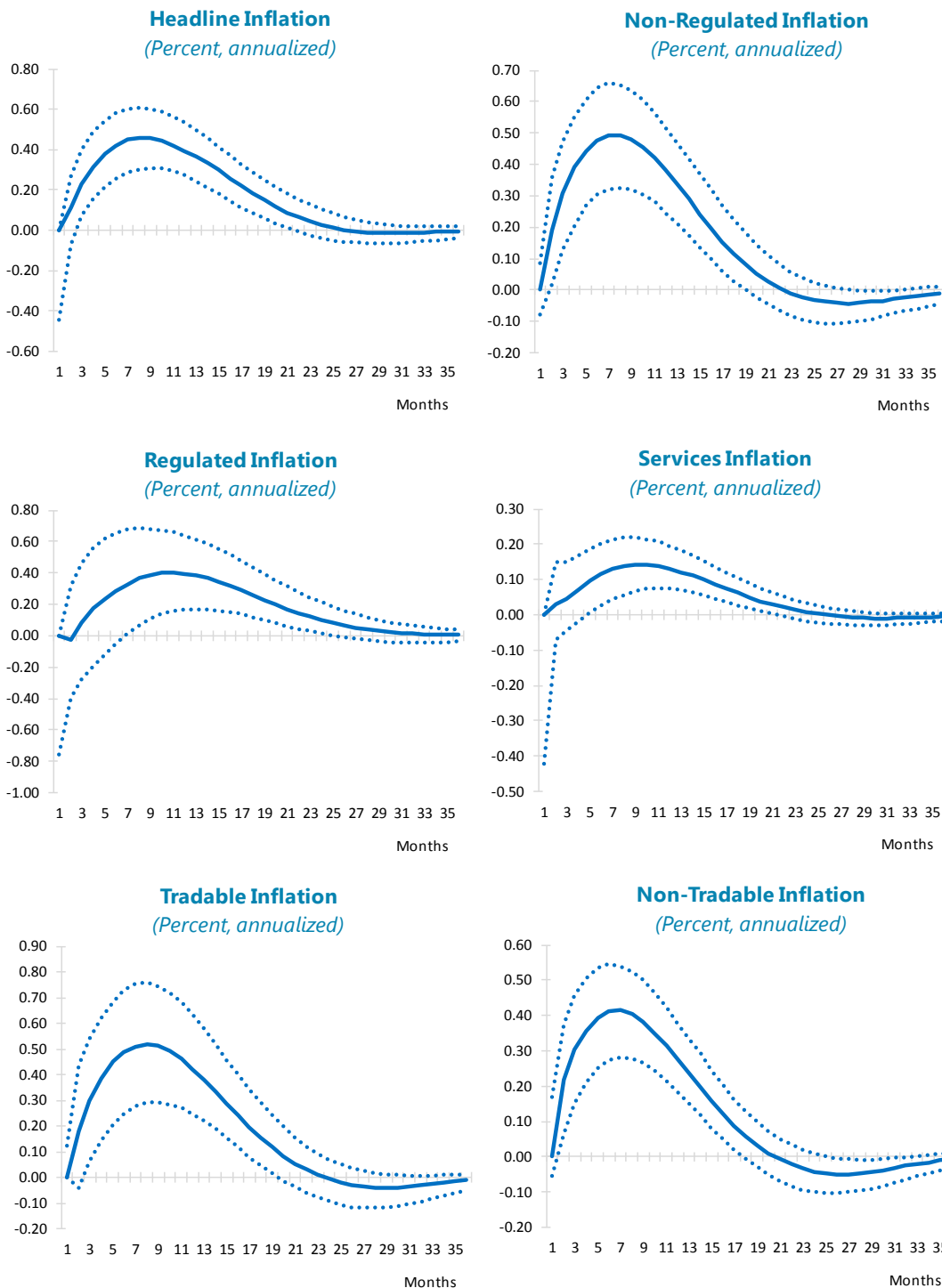
Source: Fund staff estimates.

C. Simple Model

The IS curve relates the current level of the output gap, y_t, to the lagged output gap, expectations of the future output gap and the real interest rate (deviation from steady state):

$$y_t = \delta E_t y_{t+1} + (1-\delta)y_{t-1} - \sigma(R_t - E_t \pi_{t+1} - r^*)$$

The Phillips curve relates the current level of inflation to inflation expectations, past inflation, and the output gap (where $0 \leq \alpha \leq 1$):

$$\pi_t = \alpha E_t \pi_{t+1} + (1-\alpha)\pi_{t-1} + \gamma y_t$$

The monetary policy rule relates the nominal interest rate to the steady state nominal interest rate and the expected deviation of inflation from the inflation target:

$$R_t = R^* + \mu(E_t \pi_{t+1} - \pi^*)$$

where $\mu > 1$ to ensure a unique and stable solution, and the long-run Fisher equation is:

$$R^* = r^* + \pi^*$$

The parameters values are $\sigma = 1$, $\gamma = 0.05$, $\mu = 1.5$, and $r^* = 6$, The parameters in the Phillips and IS curves related to persistence are: $\delta = \alpha = 1$, in the forward-looking model; $\delta = \alpha = 0.5$, in the partially forward-looking model; and $\delta = \alpha = 0$, in the backward-looking model.

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THE EFFECT OF FISCAL CONSOLIDATION ON REAL INTEREST RATES IN EMERGING MARKET ECONOMIES[1]

In 2016, the Brazilian authorities introduced reforms aimed at controlling the budget deficit to improve fiscal discipline, boost confidence in the economy and increase growth. In this context, the Congress passed a 20-year public spending ceiling. At the same time, Brazil has been slowly recovering from one of the most severe recessions, during which output fell by a cumulative 7.5 percent during 2015–16. In addition, real interest rates have been among the highest in Emerging Market economies (EMs), further hampering growth. Given the authorities agenda geared towards imposing fiscal discipline, we examine the relationship between fiscal consolidation episodes and real interest rates among EMs. The key findings suggest that there are beneficial, but relatively moderate and short-lived effects of fiscal consolidation on real interest rates, possibly reflecting difficulties in continuing the adjustment over a long time.

A.   Fiscal Policies in Brazil

1.   The policy agenda seeks to promote fiscal discipline. In December 2016, the authorities passed a 20-year constitutional amendment limiting growth in federal noninterest spending to the rate of consumer inflation of the previous year. To further reinforce fiscal discipline and ensure sustainability, an ambitious social security reform bill is being discussed in Congress. Provided they are successfully implemented, the set of policies is expected to put government accounts in order and invigorate business confidence and growth.

2.   The implementation of reforms is timely for Brazil as fiscal condition have been on a declining path. In the period 2013–15, the debt-to-GDP ratio increased by about 10 percentage points on average, and the cyclically adjusted primary balance (CAPB), i.e. the non-interest balance adjusted for business cycle effects,[2] has been consistently worsening since 2009 (Figure 1).

3.   Many observers think that fiscal consolidation is going to reduce interest rates. Consolidation efforts are expected by many to have positive effects by decreasing real short- and long-term interest rates, which for Brazil have been among the highest in EMs (Figure 2). Earlier studies have shown that episodes

Figure 1. Cyclically Adjusted Primary Balance in a Set of EMs
(In percent of GDP)

Sources: IMF WEO and author's calculations.

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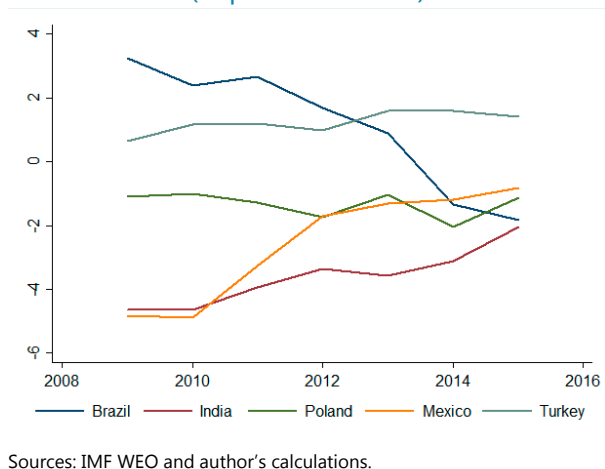
[1] Prepared by Nina Biljanovska (WHD).

[2] The methodology for the calculation of the CAPB is discussed in Section C.

of fiscal tightening are likely to be accompanied by expansionary monetary policy to offset the contractionary impact of fiscal tightening (e.g. IMF, 2010). Moreover, a suc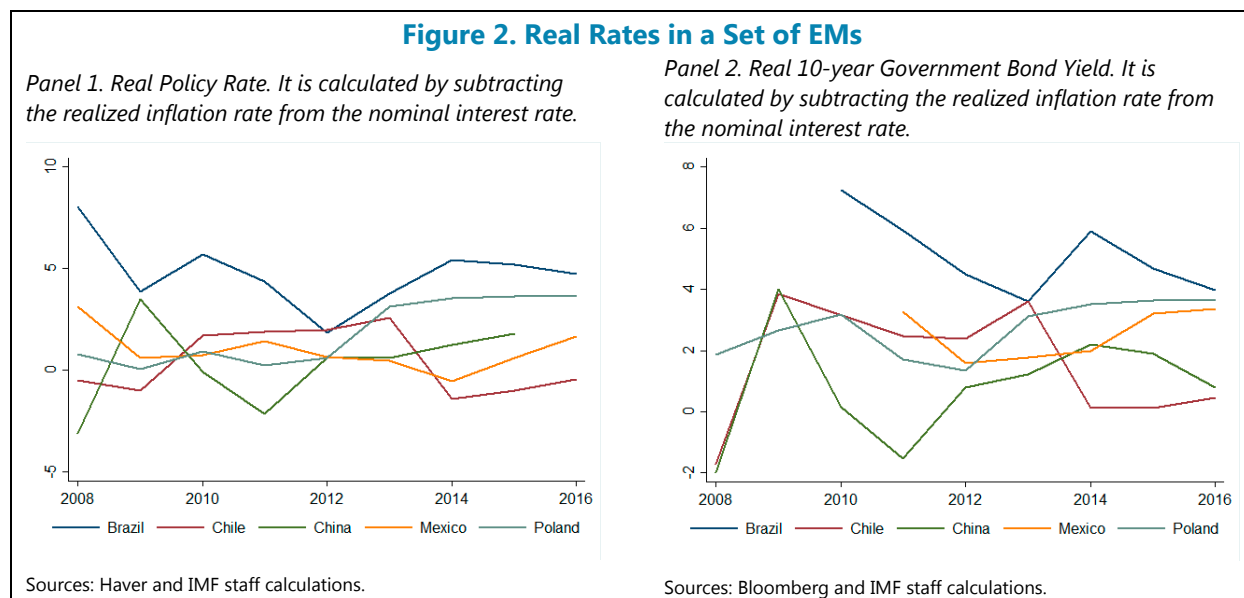cessful implementation of fiscal reforms could increase confidence, improve fundamentals and decrease the risk premium observed in long-term interest rates. To shed light on how fiscal policies could affect interest rates in Brazil, this study builds a panel dataset that consist of 73 countries and identifies episodes of fiscal consolidation during 2001–15. Then, using statistical techniques, it quantifies the effect of fiscal consolidation episodes on real short- and long-term interest rates in EMs to try to draw some lessons that may be useful in the discussion of Brazil.[3]

Figure 2. Real Rates in a Set of EMs

Panel 1. Real Policy Rate. It is calculated by subtracting the realized inflation rate from the nominal interest rate.

Panel 2. Real 10-year Government Bond Yield. It is calculated by subtracting the realized inflation rate from the nominal interest rate.

Sources: Haver and IMF staff calculations.

Sources: Bloomberg and IMF staff calculations.

B.   Fiscal Consolidation Episodes

4.   The analysis employs the so-called outcome-based approach in identifying historical cases of fiscal consolidation. Episodes are identified based on changes in the cyclically adjusted primary balance (CAPB).[4] There are different ways to calculate the CAPB.[5] The approach followed here is the one from OECD (2009):

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[3] Real interest rates are calculated using the Fisher equation, $r_t = i_t - \pi_t$, where i_t is the average annualized interest rate in year t and π_t is the realized inflation in the same year.

[4] An alternative way to identify the fiscal consolidation episodes is the action based approach (Romer and Romer, 2010), which identifies episodes based on records of fiscal actions found in historical documents (Budget Speeches, Budgets, central bank reports, IMF Staff Reports, IMF Recent Economic Developments reports, and OECD Economic Surveys, see for example Guajardo, Leigh, Pescatori, 2011). Even though this method would be preferred because of the discretionary nature of the policy actions, there is no ready-to-use dataset containing the information on such policy changes for the large sample of countries considered in this study.

[5] For example, Blanchard (1990) calculates the cyclically adjusted balance as the change between a measure of the fiscal variable at period t, computed as a function of the unemployment rate at t-1, and the actual value of the fiscal variable at t-1.

$$CAPB_t = R_t \left(\frac{\overline{Y}_t}{Y_t}\right)^{e_R} - E_t \left(\frac{\overline{Y}_t}{Y_t}\right)^{e_E}$$

where R_t denotes government revenues, E_t denotes non-interest expenditures, $\overline{Y}_t$ denotes potential output and Y_t denotes actual output; e_R and e_E are the elasticities of revenues and expenditures with respect to the output gap, which take values of 1 and 0, respectively.[6] Then, an episode of fiscal adjustment is identified using the following definition (similar to the one in Alesina and Ardagna (2012):

A fiscal adjustment is a period of 2 years during which the cyclically adjusted primary balance/GDP improves in each year and the cumulative improvement is at least two percentage points of the actual GDP.

5.   **How many episodes of fiscal consolidation were there in our sample?** Table 1 in the Appendix summarizes the episodes of fiscal consolidation that were identified based on the definition stated above. In total, there were 232 fiscal consolidation episodes for 73 countries in the period 2001−15. On average, fiscal consolidations amounted to 2.2 percent of GDP per year. For the sample of EMs, there were 35 fiscal consolidation episodes, amounting to a consolidation of 1.8 percent of GDP per year on average.[7] We also try an alternative definition of an episode, defining it as an improvement in the cyclically adjusted balance by 3 (instead of 2) percentage points of GDP. By this criterion, there were only 18 consolidation episodes identified among EMs, not allowing for reliable econometric analysis.

6.   **During the period 2001−15 no fiscal consolidation episodes were recorded for Brazil.** The public sector underwent a period of fiscal adjustment during the late 1990s, but this happened before the start of our sample period. Throughout most of the 2000s, the cyclically adjusted primary balance remained positive with an average of 2.8 percent of GDP for the period 2003−13. The balance started decreasing in 2009 before turning negative in 2014.

C.   **Econometric Specification**

7.   **To estimate the effects of fiscal consolidation on interest rates, the Local Projections (LP) method proposed by Jorda (2005), was employed.** In a nutshell, the advantage of this method is that it produces Impulse Response Functions (IRFs) using ordinary least squares (OLS). Unlike standard vector auto-regression (VAR) models, this method does not constrain the shape of the IRF, therefore permitting a more robust lag specification. Moreover, since the IRFs are obtained using OLS, interaction terms can easily be added to extend the analysis, allowing for cross-country heterogeneity. The baseline specification follows Alesina and Ardagna (2012) and IMF (2010):

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[6] These elasticities are rough approximations in the absence of country specific information, and are likely to be more accurate in the context of EMs.

[7] The sample of EMs includes the large emerging markets based on geographical areas: Brazil, Chile, China, Colombia, Czech Republic, Hungary, India, Indonesia, Korea, Malaysia, Mexico, Peru, Philippines, Poland, Russia, South Africa, Thailand, Turkey.

$$r_{i,t+h} = \alpha + \sum_{j=1}^{2} \beta_{j,h} r_{i,t-j} + \sum_{j=0}^{2} \varphi_{j,h} \Delta CAPB_{i,t-j} + \rho_h \Delta CAPB_{i,t}^{FC} + \theta_h \Delta CAPB_{i,t}^{FC,EMs} + \gamma_{i,h} + \mu_{t,h} + \varepsilon_{it},$$
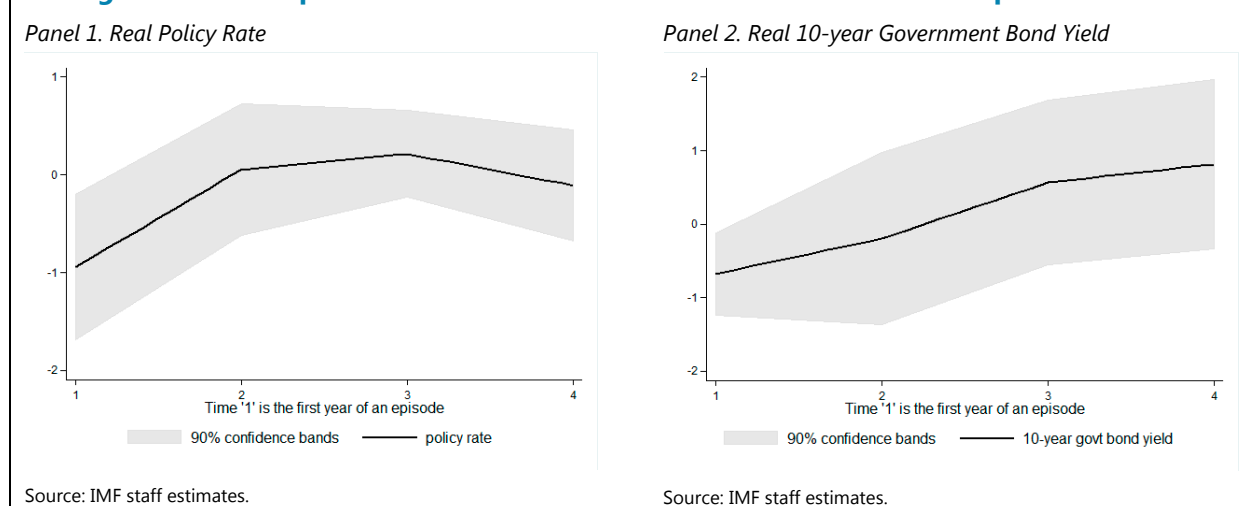
where r_{it} denotes the real policy rate or the real 10-year government bond yield, $\Delta CAPB$ is the change in the cyclically adjusted primary balance, $\Delta CAPB^{FC}$ is an interaction variable between a fiscal consolidation episode and the change in the cyclically adjusted primary balance ($Episode * \Delta CAPB$), γ_i is a vector of country fixed effects to capture country-specific characteristics, μ_t is a vector of time fixed effects to capture global business effects, and ε_{it} is the error term. Finally, $\Delta CAPB^{FC,EMs}$ is an interaction variable obtained by multiplying $\Delta CAPB^{FC}$ with a dummy variable that takes the value of 1 if a country is an emerging market and zero otherwise ($EMs * Episode * \Delta CAPB$). This interaction term allows for the coefficient θ to differ for EMs compared to all remaining countries in the sample. Then, the marginal effect, calculated as:

$$\frac{\partial r_{i,t+h}}{\partial Episode} = \rho_h \Delta CAPB_{i,t} + \theta_h EM * \Delta CAPB_{i,t}$$

depicts the responses of real interest rates to fiscal consolidation episodes. Given that the marginal effect captures how EMs respond only in comparison to other countries in the sample, we also examine the behavior of EMs alone in Section E (not relative to other economies). In both cases the findings are aligned.

8.   Fiscal consolidation episodes are accompanied by decreases in real rates in EMs. Given a fiscal consolidation episode, a one percentage point improvement in the change of the cyclically adjusted primary balance is associated with approximately 100 basis points decrease in the real policy rate (Figure 3, Panel 1). The effect is short lived, but significant for about 6 months during the period of fiscal retrenchment. Based on the experience of EMs, this suggests that fiscal consolidation episodes are accompanied by accommodative monetary policy to counterbalance the effects of fiscal consolidation. The effect of fiscal tightening appears to be less pronounced on the 10-year real government bond yield. Namely, given a fiscal consolidation episode, a one percentage point improvement in the change of the cyclically adjusted primary balance is associated with approximately a 70 basis points decrease in the real policy rate (Figure 3, Panel 2). The response is only significant initially for the first couple of months during the consolidation episode. Under the expectation hypothesis, the 10-year real rate at any point in time encompasses the average of the future short rates over the following 10 years and a risk premium. The results suggest that fiscal consolidation does affect both components, though it cannot be inferred whether the impact on expectations or the risk premium dominates. Nonetheless, the effect does not seem to be long-lasting given that the responses turn insignificantly different from zero as time progresses.

Figure 3. The Response of Real Interest Rates to Fiscal Consolidation Episodes in EMs

Panel 1. Real Policy Rate

Panel 2. Real 10-year Government Bond Yield

Source: IMF staff estimates.

Source: IMF staff estimates.

9.   One criteria to judge the success of the consolidation is by the reversals in the fiscal adjustment, which may explain the short-lived effect of tightening on interest rates. Gupta and others (2002) find that the probability of reversals in fiscal adjustment are as high as 70 percent at the end of the second year (for low income countries). In line with those findings, in the sample of countries studied here, reversals occur on average after the second year (Figure 4, Panel 1), and almost all EMs experience reversals in the fiscal adjustment during the fourth year following the consolidation (Figure 4, Panel 2).[8] These reversals are likely to explain why fiscal tightening does not appear to have a long-lasting effect on interest rates.

Figure 4. Fiscal Adjustment Reversals in EMs

Panel 1. CAPB reversals following a consolidation episode

Panel 2. CAPB reversals four years after consolidation

Source: IMF staff calculations.

Source: IMF staff calculations.

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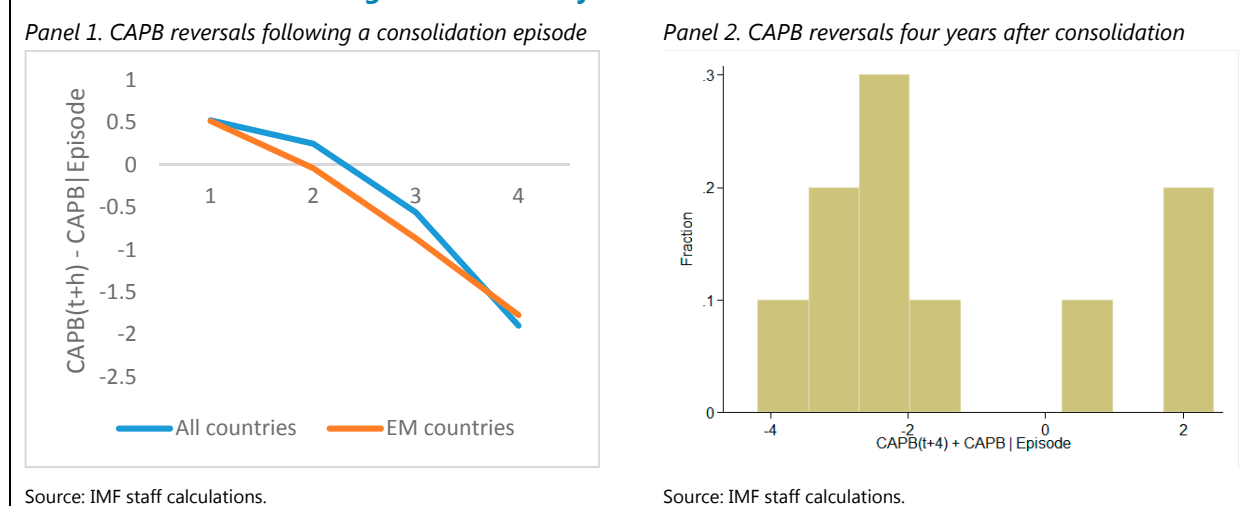
[8] Fiscal adjustment reversals are calculated as the difference between the CAPB as a percentage of GDP at period $t+h$ and period t, where h denotes the number of periods after the fiscal consolidation episode has taken place.
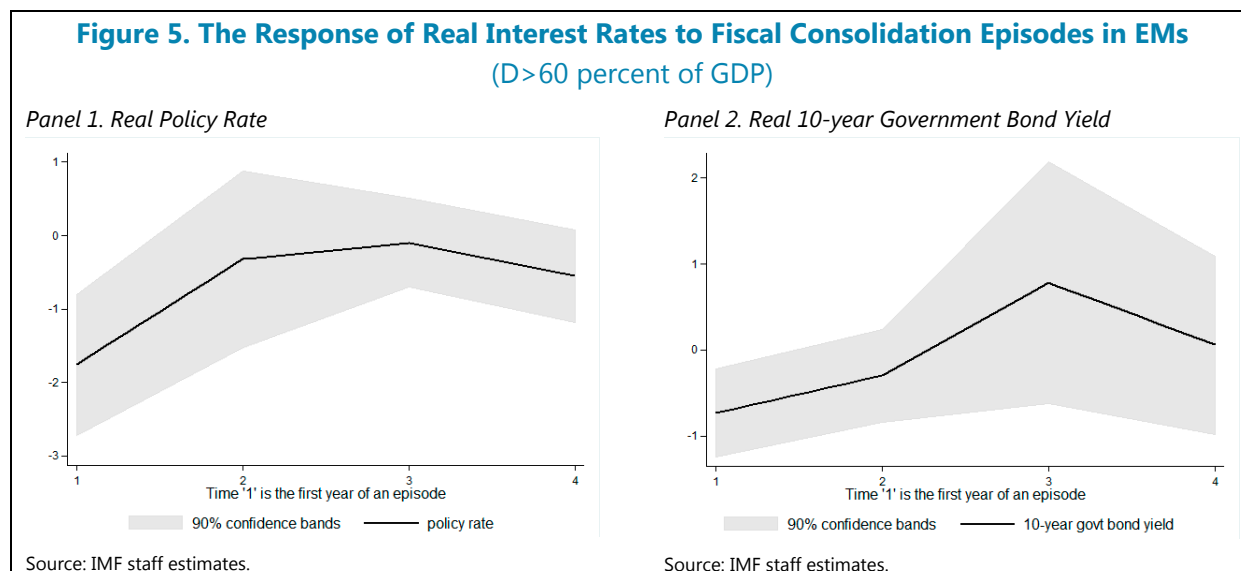
D. The Effect of Debt Outstanding

10.   Do countries with larger outstanding debt levels experience larger benefits from fiscal consolidation? There is evidence that the response of interest rates to movements in fiscal policy tends to be of larger magnitude in countries that exhibit higher outstanding debt levels (e.g. Nakamura and Yagi, 2015 among others). To examine this question, we augment the above equation by an additional term to capture the difference in response of interest rates in emerging markets with different outstanding debt levels. In this case, the above equation becomes

$$r_{i,t+h} = \alpha + \sum_{j=1}^{2} \beta_{j,h} r_{i,t-j} + \sum_{j=0}^{2} \varphi_{j,h} \Delta CAPB_{i,t-j} + \rho_h \Delta CAPB_{i,t}^{FC} + \theta_h \Delta CAPB_{i,t}^{FC,EMs} + \omega_h \Delta CAPB_{i,t}^{FC,EMs,LD}$$

$$+ \gamma_{i,h} + \mu_{t,h} + \varepsilon_{it},$$

where $\Delta CAPB^{FC,EMs,LD}$ is an interaction variable between $\Delta CAPB^{FC,EMs}$ and a dummy variable, which takes a value of one if a country has a gross outstanding debt higher than 60 percent of GDP and zero otherwise.[9]

11.   The negative relationship between interest rates and episodes of fiscal consolidation is observed also when controlling for outstanding debt levels. Given a fiscal consolidation episode, a one percentage point improvement in the change in the cyclically adjusted primary balance reduces the interest rate by almost 200 basis points (Figure 5, Panel 1). The finding is qualitatively the same as before, but quantitatively stronger. On the other hand, the response of the real 10-year government bond yield is of the same magnitude as before (around 70 basis points). However, the effect appears to be significant only during the first year while the fiscal consolidation is still ongoing (Figure 5, Panel 2).

Figure 5. The Response of Real Interest Rates to Fiscal Consolidation Episodes in EMs
(D>60 percent of GDP)

Panel 1. Real Policy Rate

Panel 2. Real 10-year Government Bond Yield

Source: IMF staff estimates.

Source: IMF staff estimates.

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[9] This threshold level, although arbitrary, is familiar owning to the Maastricht Treaty.
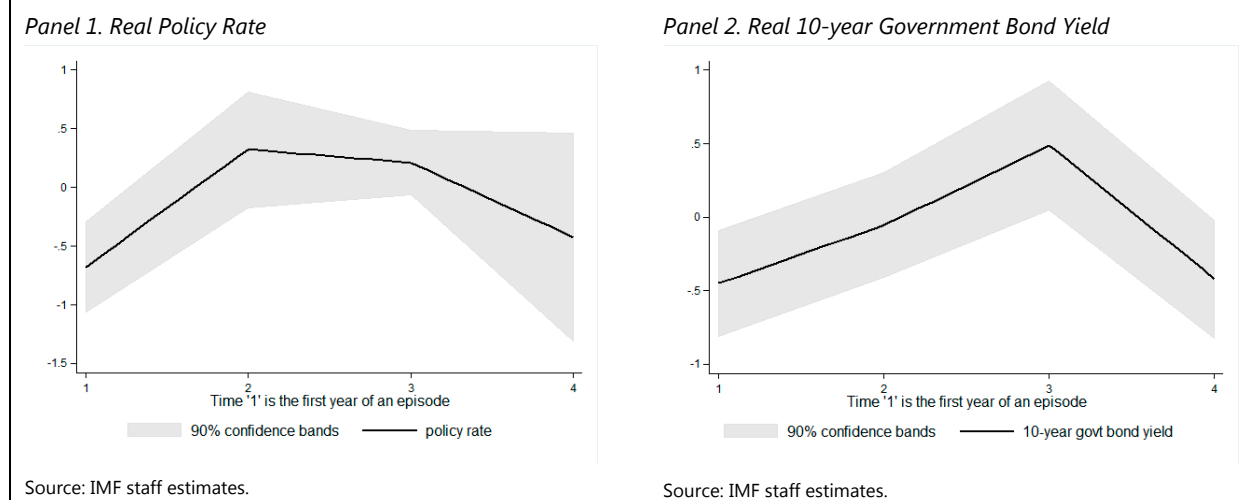
E. Robustness

12.   **Control for real GDP-per-capita.** The country fixed effects do not control for time-varying country specific characteristics. Therefore, we augment the equations above by the GDP-per-capita levels. The main results are not affected by the addition of real GDP since the coefficients on our key variables of interest, depicting the marginal effect of fiscal consolidation episodes on interest rates, remain intact. This outcome suggests that the country and time fixed effects capture the cross-country and time variation and the GDP variable is redundant in the specification.

13.   **Control for terms of trade.** Since the cyclically adjusted balance may be influenced by other factors such as the terms of trade, especially for countries that are commodity exporters, we test additional specifications by including countries' terms of trade (defined as the change in the index) as a control. The coefficient on the terms of trade variable is not significant, suggesting as before that the country and time fixed effects control for the terms of trade variation.

14.   **Change the definition of fiscal consolidation episodes.** To examine the extent to which the results are sensitive to the rate at which a fiscal consolidation episode is defined, we modify the definition of an episode to be an improvement in the cyclically adjusted balance by 1.5 (instead of 2) percentage points of GDP. In this case, the effect of fiscal consolidation on interest rates is qualitatively the same, but the responses are of somewhat lower magnitude. This result is not surprising given the more moderate degree of fiscal tightening.

15.   **Restricting the sample to EMs countries.** The earlier analyses reflect how the responses of EMs differ from the rest of the countries considered in the sample. Here, we inspect whether the same specification delivers similar conclusions on the response of interest rates to fiscal consolidation episodes when the sample is restricted only to EMs. The regression equation now excludes the interaction term $\Delta CAPB^{FC,EMs}$ and the coefficient of interest is ρ_h. Even though the sample now is smaller, the key results continue to hold. The real policy rate responds negatively to a fiscal consolidation episode, but the magnitude is somewhat lower (Figure 6, Panel 1). Similarly, the real government bond yield responds negatively to a fiscal consolidation episode with a somewhat lower magnitude (Figure 6, Panel 2). This difference in responses between the full sample and the restricted sample suggests that not only EMs respond differently to all other countries, but the negative relationship between real interest rates and fiscal consolidation episodes holds within the EM sample alone.

Figure 6. The Response of Real Interest Rates to Fiscal Consolidation Episodes in EMs
(Restricted sample to EMs only)

Panel 1. Real Policy Rate

Panel 2. Real 10-year Government Bond Yield

Source: IMF staff estimates.

Source: IMF staff estimates.

F.   Conclusion and Policy Recommendations

16.   Fiscal consolidations tend to have beneficial, but relatively moderate and short-lived effects on real interest rates. The study shows that in response to a fiscal consolidation episode, the real short-term rate is likely to decrease by approximately 100 basis points, whereas the real bond yield is expected to decrease by about 70 basis points. The effects, however, appear to be significant only for a short period, likely reflecting the proclivity of fiscal adjustments to falter and suffer reversions after a period of time.

17.   Efforts to impose fiscal discipline should be accompanied by policies aimed at alleviating the inefficiencies present in the financial sector. Based on this analysis, the fiscal policies implemented and those on the agenda are certainly in the right direction to decrease rates and allow for more stable growth in the long-run. However, fiscal problems are not the sole culprit of high rates, implying that other factors such as inefficiencies present in the financial sector could provide further explanation to the behavior of interest rates observed in Brazil.

18.   What does this mean for Brazil? In principle, we could expect some positive effects from fiscal consolidation, but it is difficult to draw definitive conclusions because of the peculiarities. Brazil's episode of fiscal consolidation will be long, but it has been preannounced, and is also accompanied by monetary easing. The main lesson to draw is that gains in interest rates can be expected if fiscal consolidation can be maintained.

Appendix I. Data

Table 1 contains the list of all the countries used in the analysis and the years for which fiscal consolidation episodes have been identified using the methodology discussed in the main text.

Table 1. Outcome-Based Approach: Episodes of Fiscal Consolidation	
Economy	Fiscal Consolidation
Albania	2002 2003
Algeria	2005 2006
Argentina	2003 2004 2012 2013
Australia	2012 2013
Austria	
Belgium	
Bosnia and Herzegovina	2002 2003 2004 2005 2006 2009 2010 2011
Brazil	
Bulgaria	2003 2004 2011 2012
Canada	
Chile	2003 2004 2010 2011
China	
Colombia	2001 2011 2012
Costa Rica	
Croatia	2012 2013 2014 2015
Cyprus	2001 2004 2005 2006 2007 2012 2013 2014
Czech Republic	2003 2004 2010 2011 2013
Denmark	2003 2004 2013 2014
Dominican Republic	2001 2002 2005 2013 2014 2015
Ecuador	2006 2007 2010 2011
Estonia	2001 2002 2003 2004 2009 2010
Finland	
France	
Georgia	2001 2004 2010 2011
Germany	2011 2012
Greece	2005 2010 2011 2012 2013
Guatemala	
Hungary	2003 2004 2007 2008 2009 2012
Iceland	2003 2004 2005 2009 2010 2011 2012 2013 2014
India	2004 2005 2006 2007
Indonesia	2001 2002
Ireland	2003 2004 2011 2012 2013 2014
Israel	2003 2004 2005
Italy	2011 2012
Jamaica	2003 2012 2013

Table 1. Outcome-Based Approach: Episodes of Fiscal Consolidation (Concluded)	
Economy	Fiscal Consolidation
Japan	2004 2005 2013 2014 2015
Jordan	2003 2004 2014 2015
Kazakhstan	2005 2006 2009 2010 2011
Korea	
Latvia	2001 2003 2004 2009 2010
Lebanon	2001 2002 2003 2005 2006 2010 2011 2014
Lithuania	2001 2002 2003 2009 2010 2012 2013 2014 2015
Malaysia	2001 2002 2004 2005
Mexico	
Morocco	2006 2007 2013 2014
Netherlands	2004 2005 2012 2013
New Zealand	2002 2003 2011 2012 2013
Norway	2004 2005 2006
Pakistan	2002 2003 2013 2014
Panama	2005 2006 2007
Peru	2005 2006 2007 2010 2011
Philippines	2005 2006
Poland	2011 2012
Portugal	2011 2012 2013
Romania	2009 2010 2011 2012
Russia	2001 2003 2004 2005 2010 2011
Serbia	2003 2004 2005 2014 2015
Slovak Republic	2003 2011 2013 2014
Slovenia	2012 2014 2015
South Africa	
Spain	2012 2013 2014
Sri Lanka	2001 2002 2003
Sweden	2004 2005
Switzerland	
Taiwan Province of China	
Thailand	2003
Turkey	
Ukraine	2002 2003 2005 2006 2009 2010 2013 2014 2015
United Kingdom	2010 2011
United States	2012 2013 2014
Uruguay	2000 2001 2002 2003
Venezuela	2002 2003 2004 2005 2006 2011 2013 2014
Vietnam	2014 2015

The data span over the period 2001–15, however the panel is unbalanced due to availability prior to 2002 with respect to the fiscal variables for some of the countries. All the variables along with the data sources are listed in Table 2. The series for GDP per capita were converted to real by using the countries' respective GDP deflators from the WEO database. Potential output was estimated using the HP-filter with a penalizing parameter set to 6.5, which corresponds to yearly data.

The sample of Emerging Market economies (EMs) includes the largest EMs based on geographical area: Brazil, Chile, China, Colombia, Czech Republic, Hungary, India, Indonesia, Malaysia, Mexico, Peru, Philippines, Poland, Russia, South Africa, Korea, Thailand, Turkey.

Table 2. Data Sources	
Variable	Source
Real GDP (total)	WEO Database
Real GDP (per capita)	WEO Database
Government revenues (general)	WEO Database
Government expenditures (general)	WEO Database
Government interest payments, staff calculations	WEO Database
Government debt as a percentage of GDP	WEO Database
Policy interest rate	National authorities (Haver), Bloomberg Financial Markets
10-year government bond yield	Bloomberg Financial Markets

Appendix II. Methodology

The Local Projection (LP) method, suggested by Jorda (2005), comprises of projecting the future behavior of the dependent variable (real interest rates in this study) on an unchanged set of explanatory variables. Then, a series of regressions are estimated in which the set of explanatory variables remains unchanged and only the dependent variable is being forwarded one period ahead for every regression. The coefficients of interest, depicting marginal effects, are stored and plot as impulse responses. More specifically, for the regression equation in Section C, the marginal effects of a fiscal consolidation episode on interest rates are given by

$$\frac{\partial r_{i,t+h}}{\partial Episode} = \rho_h \Delta CAPB_{i,t} + \theta_h EM * \Delta CAPB_{i,t}.$$

In this way, the coefficients above trace the response of interest rates at $t+h$ to a fiscal consolidation episode that has occurred at time t.

One of the challenges that this estimation poses is the serial correlation due to lagging and successive leading of the dependent variable. Furthermore, it assuming cross-sectional independence of the error terms might be problematic. To control for both serial correlation and cross-sectional dependence we use Driscoll-Kraay standard errors.[1]

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[1] Driscoll and Kraay (1998) suggest an estimator that generates heteroskedasticity and autocorrelation-consistent standard errors that are also robust to cross-sectional dependence (see for e.g. Caselli and Roitman, 2015).

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BOOSTING PRODUCTIVITY: TAXES AND RESOURCE MISALLOCATION IN BRAZIL[1]

A. The Productivity Challenge in Brazil

1. Once Brazil recovers from its recent economic crisis, raising productivity will remain a top priority challenge. Brazil has struggled for several decades to generate strong and sustained productivity growth, the key driver of living standards over the long term. Brazil's productivity grew by only 1.6 percent a year between 2001 and 2013 (Figure 1). By comparison, China and Russia, also considered emerging economies, saw their productivity rates rise by 9.6 and 3.5 percent, respectively (Ceratti, 2016).

Figure 1. Labor Productivity Growth in Selected Countries

Source: World Bank
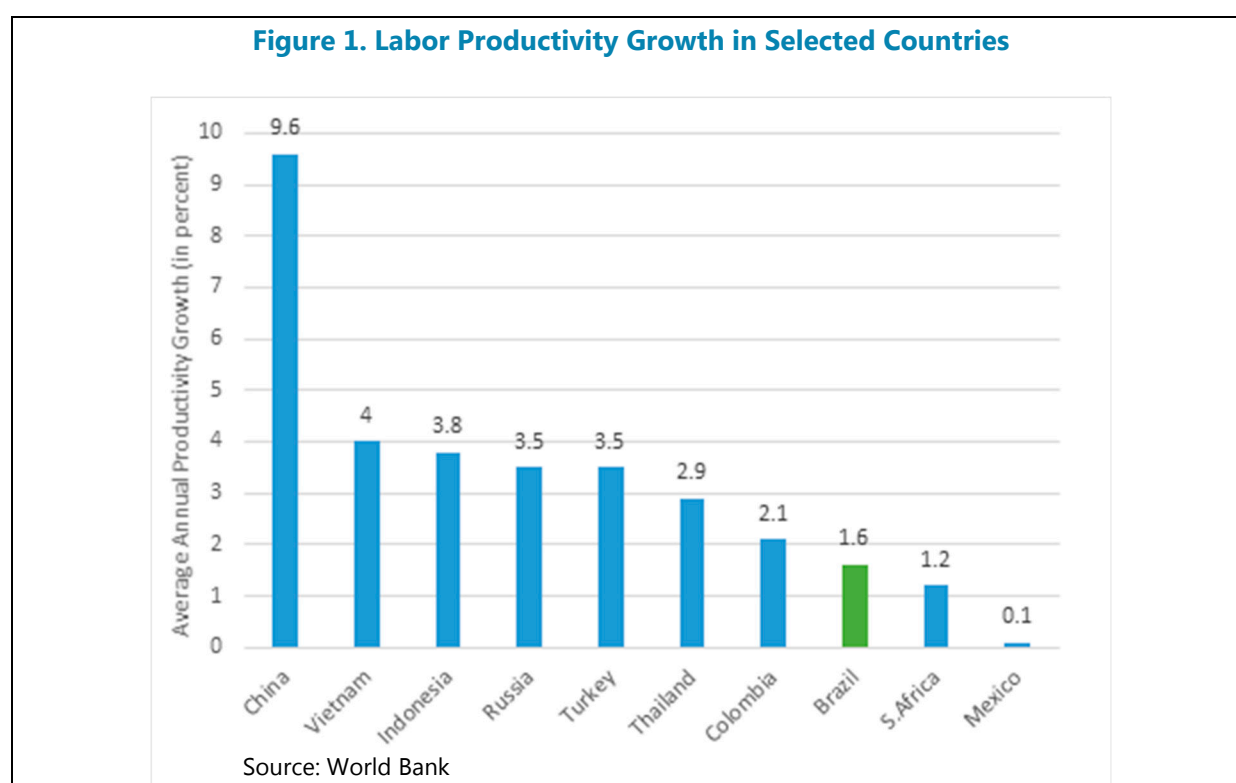
2. Brazil's productivity malaise can be explained by multiple factors, including significant resource misallocation. At the macroeconomic level, weak productivity growth can be explained by multiple factors, such as a high cost of finance and doing business, a poor state of the country's physical infrastructure, limits to competition resulting from domestic regulation, trade barriers, and inadequate skills of the labor force (World Bank, 2016). At the microeconomic level, lack of total

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[1] Prepared by Henrique Fialho Barbosa (WHD) and Carlos Mulas-Granados (FAD), based on the IMF's Fiscal Monitor chapter on the same topic (IMF, 2017).

factor productivity growth reflects weak productivity performance by individual firms, which is typically related to the poor use of existing resources (labor and capital) within the country.

3.   **Reducing resource misallocation is a multidimensional task which requires upgrading the tax system.** Resource misallocation is often the result of many poorly designed economic policies and market failures that prevent the expansion of efficient firms and promote the survival of inefficient ones. Reducing misallocation therefore requires the use of multiple policy levers, including structural (financial, labor, and product market) reforms which have proved successful in improving resource allocation efficiency.[2] This appendix makes the case that upgrading the tax system in Brazil is also key to boosting productivity by reducing distortions that prevent resources from going to where they are most productive.
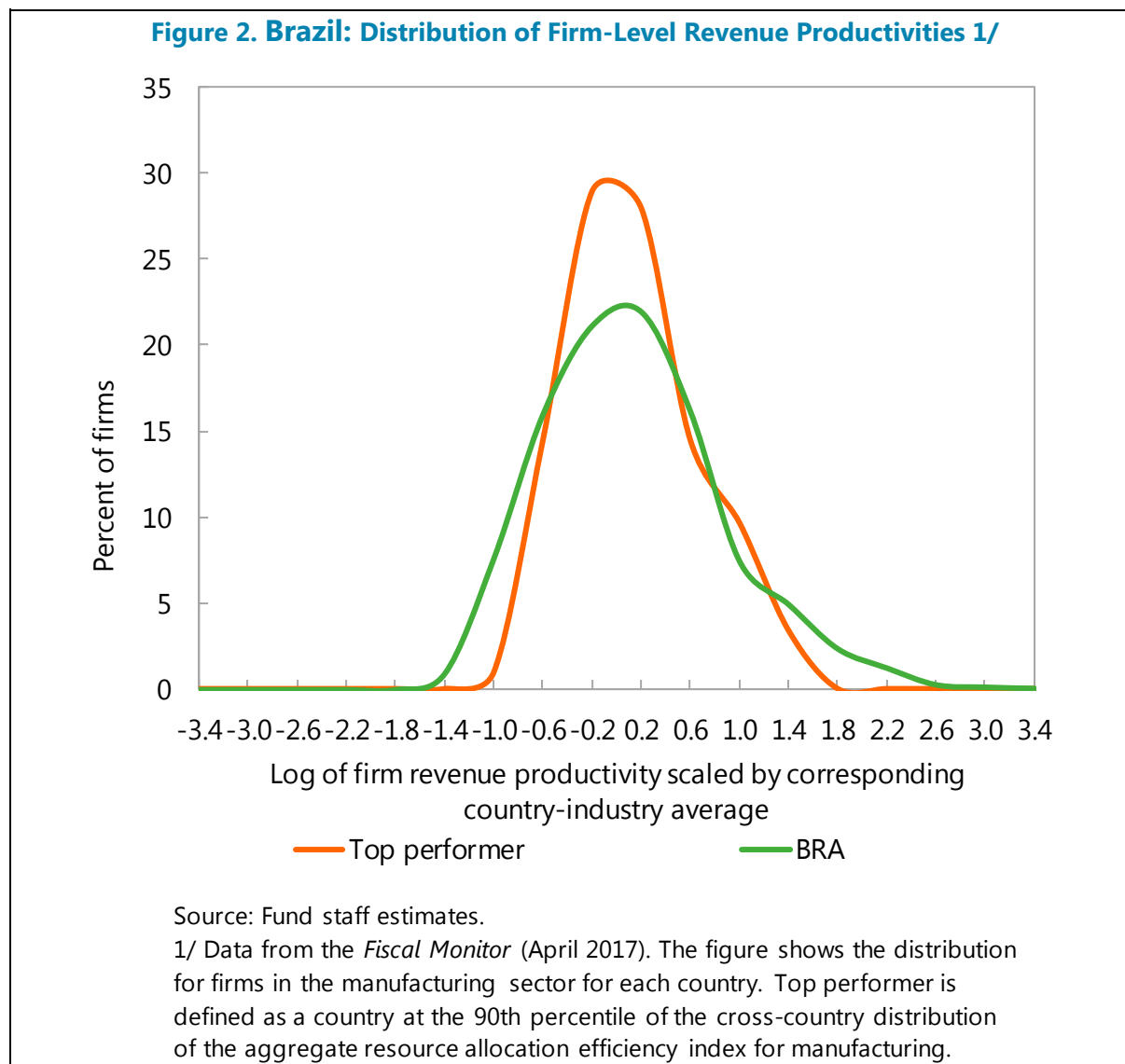
B.   Resource Misallocation in Brazil

4.   **Resource misallocation reflects a poor distribution of resources across firms, reducing the total output that can be obtained from existing capital and labor.** Resource misallocation is apparent in the dispersion in revenue productivity levels across firms, even within narrowly defined industries that produce similar goods. When dispersion is wide, reallocating resources from firms with low revenue productivity to firms with high revenue productivity increases output, simply by using the same resources differently. For example, imagine a situation in Brazil with two firms within the same industry that have identical technologies but face different tax treatments. This could happen if an inefficient small firm benefits from the tax exemptions under the SIMPLES tax regime, which is available to companies below a certain revenue threshold. In that case, the larger efficient company, using the economies of scale generated by its more efficient use of resources, would be fully taxed. In this scenario, aggregate output would be higher if capital were reallocated toward the more efficient firm, resulting in more investment in higher return projects. However, some resources would remain employed in inefficient firms that could afford to undertake investments in projects with lower pre-tax returns and survive thanks to lower taxation.

5.   **Brazil suffers from significant resource misallocation, as captured by high dispersion of revenue productivities across firms.** Borrowing the data and the methodology from the IMF's Fiscal Monitor (IMF, 2017), Figure 2 illustrates the dispersion in firm-level revenue productivities in Brazil and the top performing country in the sample.[3] The figure shows that dispersion in the more efficient country is much narrower than that observed in Brazil. Consequently, Brazil would be able to reap substantial gains if it were able to move resources from those firms with lower productivity (on the left tail of the distribution) to those with higher revenue productivity (those in the right tail).

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[2] For selected advanced economies, Dabla-Norris and others (2015) show that TFP gains from improving factor allocation across sectors average about 9 percent.

[3] According to Hsieh and Klenow (2009), "revenue productivity (the product of physical productivity and a firm's output price) should be equated across firms [in the same industry] in the absence of distortions. To the extent revenue productivity differs across firms, we can use it to recover a measure of firm-level distortions."
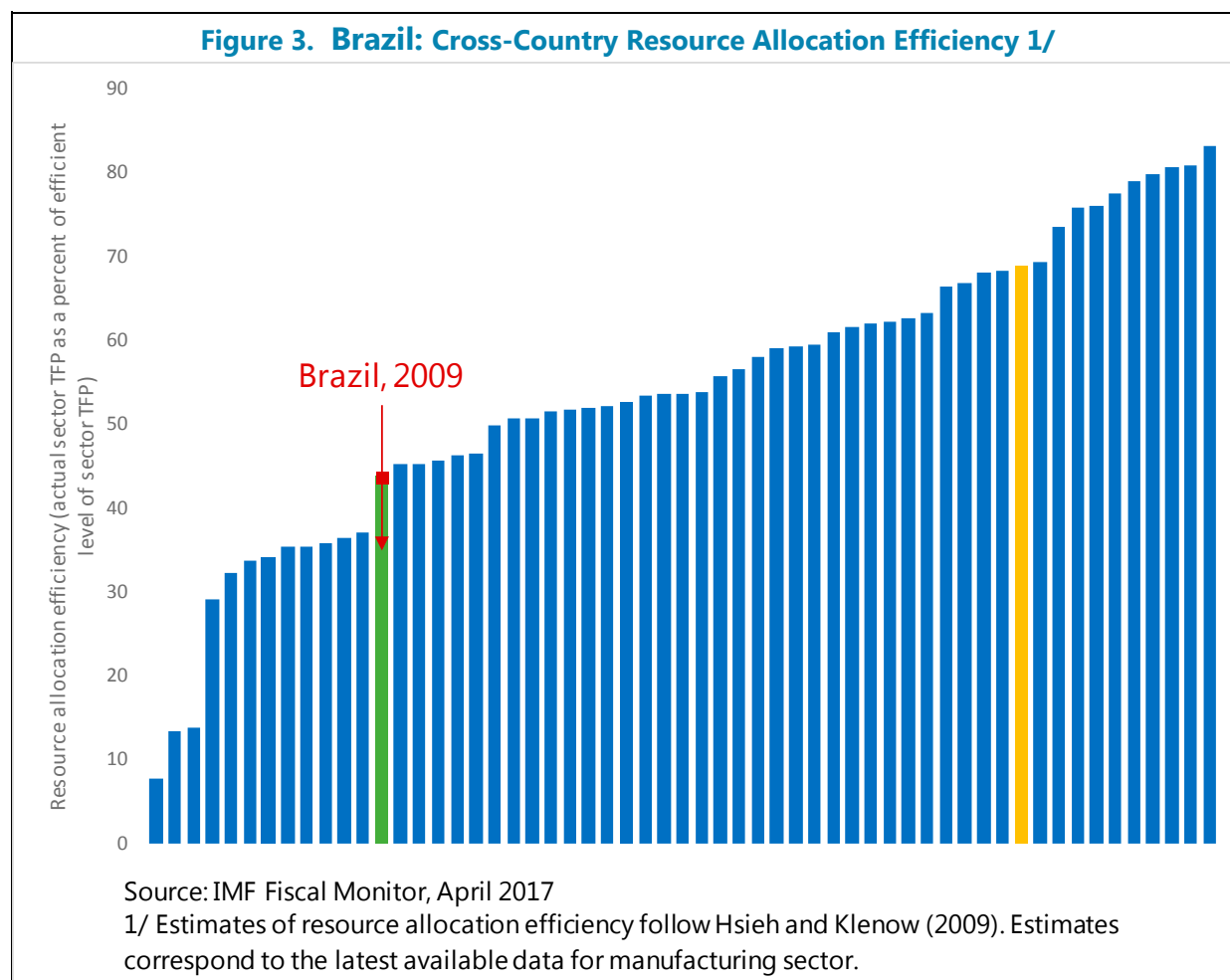
Figure 2. Brazil: Distribution of Firm-Level Revenue Productivities 1/

Log of firm revenue productivity scaled by corresponding country-industry average

— Top performer — BRA

Source: Fund staff estimates.
1/ Data from the *Fiscal Monitor* (April 2017). The figure shows the distribution for firms in the manufacturing sector for each country. Top performer is defined as a country at the 90th percentile of the cross-country distribution of the aggregate resource allocation efficiency index for manufacturing.

6.   In a fully efficient and frictionless equilibrium, Brazil could potentially increase its total factor productivity by nearly 60 percent. If marginal products were equalized within each industry, industry-level TFP would be at an efficient level. The Resource Allocation Efficiency ratio (RAE) is the ratio of actual TFP to this efficient TFP, aggregated across sectors.[4] Figure 3 plots the Resource Allocation Efficiency (RAE) for all 67 countries in the sample.[5] It shows that Brazil is in the bottom third of the distribution. Implementing reforms to help Brazil to transition from its current level of efficiency to the level of the country in the 90th percentile of the distribution (in red) could increase Brazil's total factor productivity by 57.3 percent. These estimates of TFP gains present a

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[4] Using a Cobb-Douglas aggregator.

[5] Using firm-level data for 10 advanced economies (from ORBIS database) and 57 developing countries (from World Bank Enterprise Surveys), the Fiscal Monitor (IMF, 2017) calculates resource allocation efficiency for each industry within each country.

lower bound. While within-industry misallocation accounts for the bulk of cross-country productivity differences, reducing misallocation across broad economic sectors can also spur aggregate productivity and output. Although these numerical estimates should be treated with caution, as they are subject to statistical error like all estimates, they strongly suggest that Brazil could stand to gain much if it could take steps to improve resource allocation and productivity.

Figure 3. Brazil: Cross-Country Resource Allocation Efficiency 1/

Source: IMF Fiscal Monitor, April 2017
1/ Estimates of resource allocation efficiency follow Hsieh and Klenow (2009). Estimates correspond to the latest available data for manufacturing sector.

7.   Potential TFP gains from reducing resource misallocation could lift annual real GDP growth rate by roughly 2 percent of GDP. By comparing the gains in TFP and, consequently, the gains in output that could result from some interventions to reduce specific distortions, it is possible to estimate the GDP growth effects from such interventions. Assuming a transition path of 20 years, reducing resource misallocation (by moving Brazil to the 90th percentile of the distribution of resource allocation efficiency) translates into a higher annual real GDP growth rate of 2.29 percent for Brazil.[6] One way to read this estimate is that when one considers the distance in output per capita between Brazil and the group of more developed/productive countries today, a substantial

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[6] We assume a transition period of 20 years to make our results comparable to those calculated for other countries in the world (see IMF, 2017).

fraction could be made up just by improving the way Brazil uses the resources it already has. Of course, moving resources from one part of the economy to another is a slow process, hence the assumption of a 20-year period for catching up to the higher standard of resource allocation efficiency. In any case, as shown in Figure 4, these gains would be much higher than average gains for emerging market economies or the five largest economies in Latin America (LA5), partially because Brazil starts further behind in terms of allocation efficiency.

Figure 4. Brazil: Growth Impact from Improving Resource Allocation Efficiency 1/
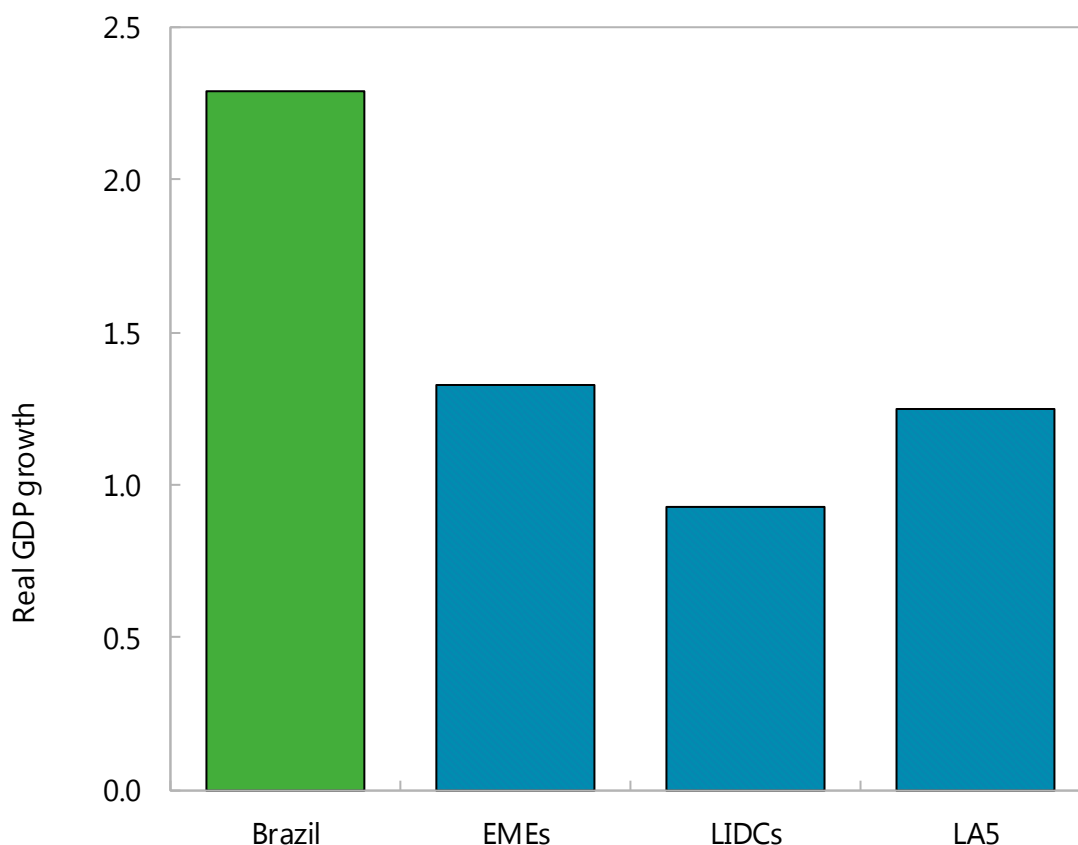
Sources: April 2017 Fiscal Monitor.
1/ The figure shows medians across country groups. Estimates are computed based on the assumption that the other sectors could achieve TFP gains similar to those estimated for the manufacturing sector and that there are no adjustment costs. EMEs = emerging market economies; LIDCs = low-income developing countries; LA5 = Median for Brazil, Chile, Colombia, Mexico, Peru.

C.   Upgrading the Tax System to Reduce Resource Misallocation

8.   Among other factors, upgrading the tax system is key for reducing resource misallocation and increasing productivity and growth. Several policies may be behind high levels

of resource misallocation. For example, Restuccia and Rogerson (2013, 2016) survey the literature and point to legislated provisions that vary by firm characteristics (for example provisions of the tax code that vary with size, tariffs applied to particular goods, employment protection measures, or product market regulations that limit market access); discretionary provisions made by the government that favor specific firms (for example subsidies, selective tax enforcement, or preferential loans); and market imperfections (for example monopoly power or incomplete financial markets). For Brazil, De Vries (2014) shows that taxes, regulation and access to credit create distortions to output and capital that vary by firm size, thus generating resource misallocation. Appy (2017) explains that the tax system in Brazil generates allocative distortions by altering the relative prices of labor and capital, and by inducing a suboptimal allocation of production by sectors and regions.

9.   Distortive tax policy and tax administration are among the important factors that policymakers need to bear mind when tackling the productivity challenge in Brazil. [11] Below, we examine a selection of tax policies to explore the channels through which they generate resource misallocation in Brazil, and provide some estimates for potential gains, based again on the methodologies outlined in the Fiscal Monitor (IMF, 2017). The analysis includes taxes that discriminate across capital asset types (leading to differentiated treatment of firms as the propensity to use the various asset types as input varies across firms), across firm characteristics such as their sources of financing (debt or equity), and their degree of informality.[7]
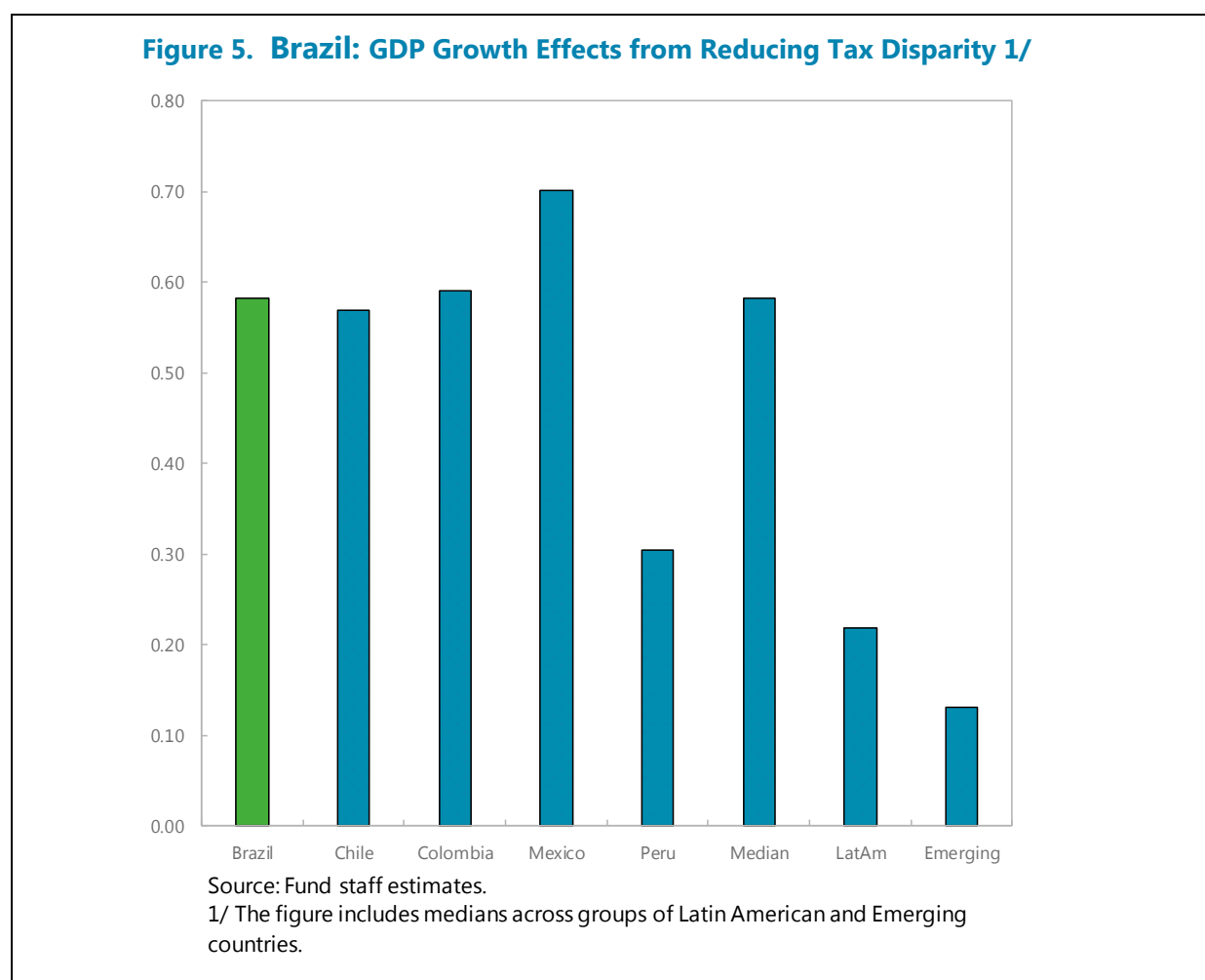
Tax Disparity

10.   When disparities in effective tax rates across asset types push investors toward lower-return, tax-favored projects, resource misallocation increases. One way in which the tax code introduces distortions in the economy is by differential taxation across factors of production. In this situation, firms will choose their factor allocations partly based on tax concerns, displacing productive concerns. Also, firms that are factor-intensive on the privileged factor can afford being less productive and still be competitive due to their tax advantage. A standard method to estimate resource misallocation driven by tax disparity is to compare effective marginal tax rates (EMTRs) across various types of assets.[8] The significant variation in EMTRs for various asset types in Brazil and half of the countries shown in the Fiscal Monitor (IMF, 2017) arises from differences between the rates at which the tax code allows businesses to deduct the cost of assets (known as tax depreciation) and the rates at which those assets actually wear out or become obsolete (economic depreciation).

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[7] Because industry or firm specific tax policy indicators are not readily available for a wide set of countries, like in the Fiscal Monitor (IMF, 2017) most of the analyses in this section rely on a difference-in-differences approach to assess the effect of tax distortions on resource misallocation.

[8] The EMTR on capital income measures the tax burden applied to before-tax capital income realized over an investment's lifetime, implied by major provisions of the corporate tax code. These major provisions include the statutory federal tax rates, surcharges, local tax rates, depreciation rates and accelerated depreciation, treatment of inventories, and interest deductibility.

11.   Reducing resource misallocation associated to tax disparity in Brazil can increase productivity and growth significantly. The differential taxation between machinery and buildings could be used an indirect measure of the differential taxation between capital-intensive and labor-intensive industries leading to resource misallocation. Brazil suffers from the effects of high tax disparity, meaning that there are higher effective taxes for machines than for buildings. This explains why the country tends to have a lower share of machinery, compared to those countries with lower tax disparity. Eliminating most of the existing tax disparity and bringing Brazil to the level of tax disparity existing at the 90th percentile of the distribution, would raise resource allocation efficiency in Brazil by 12.3 percentage points and increase annual GDP by 0.58 percentage points (Figure 5). This potential improvement would be four times larger than the potential gain for emerging economies and three times the gains for the group of Latin American economies.[9]

Figure 5. **Brazil:** GDP Growth Effects from Reducing Tax Disparity 1/

Source: Fund staff estimates.
1/ The figure includes medians across groups of Latin American and Emerging countries.

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[9] Note that underlying data for Brazil used in the Fiscal Monitor (IMF, 2017) is from 2009 as reported by the World Bank Enterprise Survey. This is when still Brazil was still among the best performing emerging markets, a situation which has changed since 2014 due to one of the deepest recessions in its history. Therefore, inefficiencies may be larger now and gains from reducing resource misallocation could be even higher today.
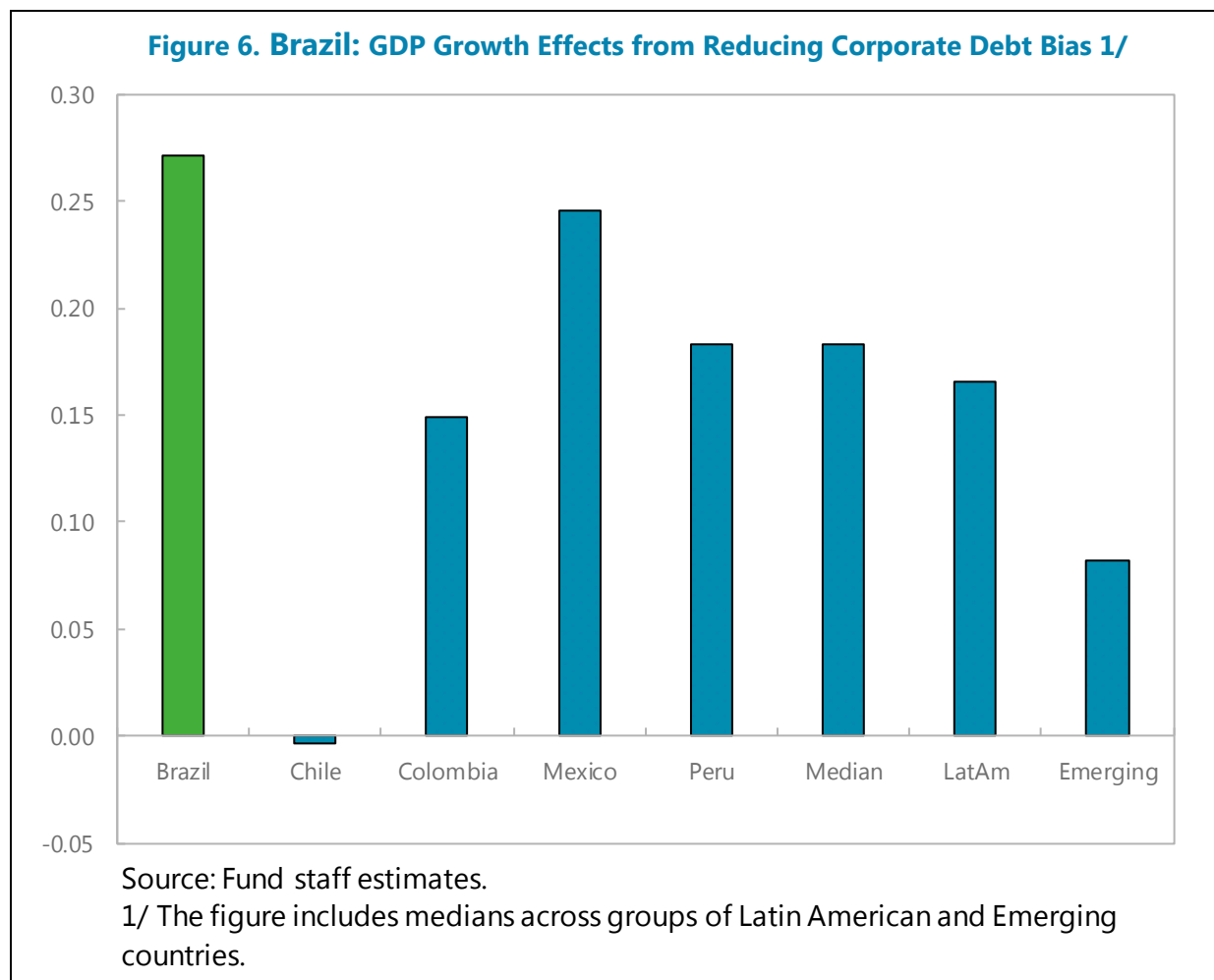
The group of Latin American countries includes Argentina, Belize, Bolivia, Chile, Colombia, Costa Rica, Ecuador, El Salvador, Falkland Islands, French Guiana, Guatemala, Guyana, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Suriname, Uruguay and Venezuela. The group of Emerging countries includes Chile, China, Colombia, Czech Republic, Egypt, Greece, Hungary, India, Indonesia, South Korea, Malaysia, Mexico, Peru, Philippines, Poland, Qatar, Russia, South Africa, Taiwan, Thailand, Turkey, and United Arab Emirates.

Corporate Debt Bias

12.   Giving tax breaks to debt but not to equity financing of risky projects increases resource misallocation. Governments can introduce distortions by privileging some financing methods over others. Corporate debt bias occurs when firms are allowed to deduct interest expenses, but not returns to equity, in calculating corporate tax liability, raising the cost of equity financing compared to debt financing. Many young companies, especially innovative ones and R&D-related startups finance their operations with equity due to the risky nature of their businesses because there are no collateral requirements and shareholders share in upside returns (Stiglitz, 1985; Hall, 2002; Brown and others, 2009). Therefore, corporate debt bias induced by the tax system not only distorts the financing choice, but it can also create resource misallocation by imposing a higher marginal tax on R&D investment compared to other capital spending.

13.   Reducing the corporate debt bias can help increase productivity and growth associated to innovative companies. The debt bias can be measured as the EMTR on equity minus the EMTR on debt.[10] The results from the Fiscal Monitor (IMF, 2017) show that R&D intensive industries—which are more exposed to debt bias—have lower resource allocation efficiency in countries where debt bias is higher. Using these estimates, we calculate that if Brazil were to reduce its corporate debt bias to the level observed in the 10th percentile of the sample (thus moving the country to the 90th percentile of the distribution of resource allocation efficiency), it could raise its resource allocation by 5.56 percentage points and annual GDP growth in Brazil by 0.27 percentage points (Figure 6). These gains would be 40 percent higher than for the average of Latin American countries and almost three times larger than for the average of Emerging countries.

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[10] Note that in the case of debt-financed investment, the combination of interest deductions and accelerated depreciation can exceed taxes paid on the associated income, resulting in negative EMTRs.

Figure 6. Brazil: GDP Growth Effects from Reducing Corporate Debt Bias 1/

Source: Fund staff estimates.
1/ The figure includes medians across groups of Latin American and Emerging countries.
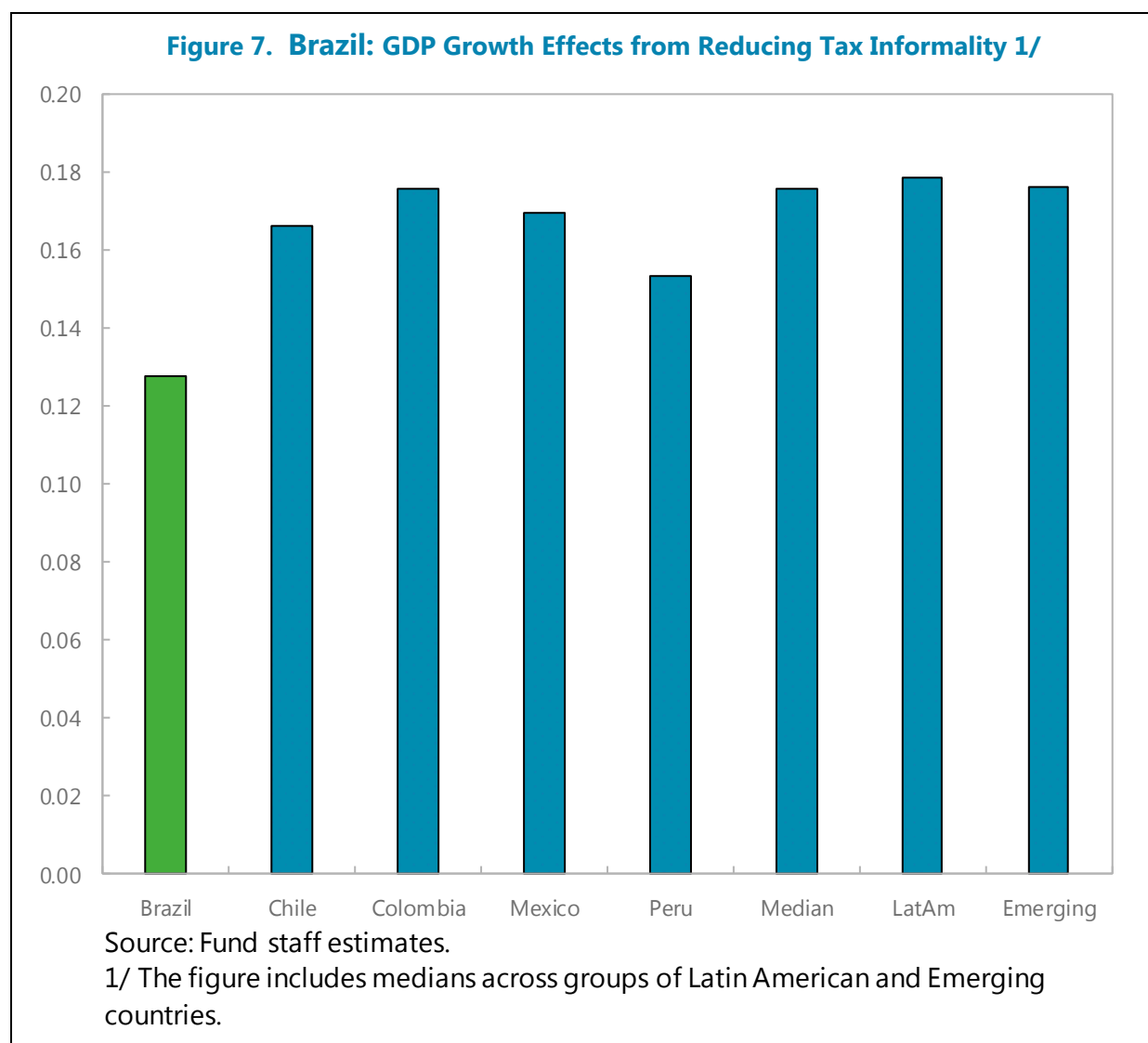
Tax Informality

14.   Tax informality is not only a problem for revenue collection but also for productivity.
The literature defines informal firms are those that fail to pay the full amount of tax due, recognizing that there are many reasons why a firm or individual might not pay taxes (Kanbur and Keen, 2014). Noncompliance with taxes reduces productivity by interfering with firm entry and exit. Informal firms enjoy a relative cost advantage over their tax compliant competitors through tax evasion and circumvention of regulations. This allows informal firms to stay in business despite their low productivity, increasing their weight in the economy at the expense of more productive firms.

15.   Reducing tax informality in Brazil can help increase productivity and growth further.
Results from the Fiscal Monitor (IMF, 2017) suggest that, as tax enforcement improves and the prevalence of informality falls among registered firms, less productive firms will exit the market, releasing resources that can then migrate to more productive firms. Reducing tax informality to the level of the best performers can increase productivity in Brazil by 2.58 percentage points and annual GDP by 0.12 percentage points (Figure 7). While significant, these gains would be smaller in Brazil

than in the groups of Latin American and Emerging countries, reflecting the improvements that Brazilian tax administration has experienced in the last decades.

Figure 7. **Brazil: GDP Growth Effects from Reducing Tax Informality 1/**

Source: Fund staff estimates.
1/ The figure includes medians across groups of Latin American and Emerging countries.

D.   Conclusions and Policy Recommendations

16.   **Resource misallocation in Brazil is significant.** Resource misallocation arises from distortions that prevent the expansion of efficient firms and promote the survival of inefficient ones. It is apparent in a wide dispersion in productivity levels across firms, even within narrowly defined industries.

17.   **Brazil can reap substantial TFP gains from reducing resource misallocation.** By enabling firms to catch up with the productivity frontier, Brazil can reduce resource misallocation. Using methodologies developed in the Fiscal Monitor, it is possible to estimate that reducing resource

misallocation could increase productivity by more than 50 percentage points in Brazil. In other words, the evidence suggests that with existing resources, and simply by improving the way these are used, output could be that much higher. If one could imagine that a reallocation of resources could be implemented gradually over 20 years in such a way that Brazil's levels of efficiency could catch up with those of leading countries, that would boost annual GDP growth by more than 2 percentage points during this catch-up period. While these estimates are subject to statistical uncertainty, like any estimates of this type, they are suggestive of the scope for improvement that is available to Brazil if it can focus on a productivity-increasing agenda.

18.   **Resource misallocation can be reduced by upgrading the tax system.** Distortions are created by several factors, like poorly designed economic policies and market failures. The tax system is also an important factor. Countries, such as Brazil, can reap TFP gains by upgrading the design of their tax system, to ensure that firms' decisions are made for business reasons and not tax reasons. Significant gains can also be achieved if Brazil addresses tax treatments that discriminate by asset type, sources of financing, or by firm characteristics such as tax informality. The estimates shown in the preceding sections suggest that by addressing tax-related distortions, Brazil could bridge about half of the gap in productivity relative to leading countries. Again, exact estimates of potential gains need to be taken with caution; but they confirm that there are important benefits for the country that can be reached by pursuing a well-designed, productivity-oriented tax reform.

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