



In This Issue

- 1 Tax Capacity and Growth: Is There a Tipping Point?
- 4 U.S. Shale Revolution and Its Spillover Effects on the Global Economy
- 7 Q&A: Seven Questions about the Relationship between Country Finance and Governance
- 10 Conference Call for Papers
- 11 IMF Working Papers
- 14 Recommended Readings from IMF Publications
- 15 IMF Economic Review
- 16 Staff Discussion Notes

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Tax Capacity and Growth: Is There a Tipping Point?

Vitor Gaspar, Laura Jaramillo, and Philippe Wingender



Is there a minimum tax-to-GDP ratio associated with a significant acceleration in the process of growth and development? We give an empirical answer to this question by investigating the existence of a tipping point in tax-to-GDP levels. We use two separate databases: a novel contemporary database covering 139 countries from 1965 to 2011 and a historical database for 30 advanced economies from 1800 to 1980. We find that the answer to the question is yes. Estimated tipping points are similar at about 12¾ percent of GDP. For the contemporary dataset we find that a country just above the threshold will have GDP per capita 7.5 percent larger, after 10 years. The effect is tightly estimated and economically large.

Building tax capacity is closely linked to the process of economic development and growth. There is a long intellectual history behind this concept of the role of taxes and the state. Joseph Schumpeter, in his famous paper “The Crisis of the Tax State” (Schumpeter, 1918), links the state and tax so closely that he stresses that “tax” in “tax state” can be regarded as almost redundant. He emphasizes that taxes are not only associated with the historical origin of the state, they are also active in shaping it. In his view, the organic development of taxation was associated with the organic development of other dimensions of the state. For Schumpeter, the analysis of the consequences of taxation requires a long-run perspective that allows for structural and self-reinforcing evolutionary dynamics to play out in full. Those are not only economic, but also social and political.

In contemporary research, Besley and Persson (2011, 2013, 2014) emphasize the broader concept of state capacity to stand for a range of capabilities that are needed for the state to function effectively. We follow Besley and Persson and argue that state capacity is shaped by the interaction between tax capacity, legal capacity, and public administration capacity. Tax capacity provides a stable and elastic source of revenue for the government to finance government activities. Also, a government with a larger stake in the economy through a developed tax system has stronger motives to play a productive role in the

Read more on page 2

economy. Public administration capacity refers to the government's effective and efficient use of public money. This directly impacts the ability of governments to implement policy and deliver public services, which in turn influences citizens' trust in government. Legal capacity refers to the government's ability to secure private property rights. This includes legal infrastructure such as building the court system and registering property.

The strength of tax capacity depends crucially on social norms of compliance. Kiser and Levi (2015) emphasize that the more a government is effective and trustworthy, the more legitimacy it is likely to attain, and the more it will be able to elicit compliance without excessive monitoring or punitive action. The government can thereby achieve a high degree of quasi-voluntary compliance with the taxation system as proposed by Levi (1988).

A shift in social norms can push a country out of a low tax compliance equilibrium into a high tax compliance equilibrium as discussed, for example, by Traxler (2010). Such enhanced tax capacity could then lead to a virtuous cycle in behavior and institutions that will have a positive impact on growth. The virtuous cycle could be triggered through several channels. Greater tax compliance enlarges the tax base, which can reduce the marginal cost of public funds. In turn, this enables greater spending by the government on state capacity building. An increase in cooperative behavior and trust can also make it easier to realize agglomeration effects in production as more individuals and firms participate in formal markets.

This raises the question: Is there a minimum tax-to-GDP ratio associated with a significant acceleration in the process of growth and development?

We argue that as countries approach and eventually exceed some revenue threshold, growth outcomes for these countries would then jump discontinuously. Card, Mas, and Rothstein (2008) demonstrate that tipping points can be identified and estimated through the use of regression discontinuity design (RDD) methods. We apply the approach to the relation between tax-to-GDP levels and subsequent GDP growth. In particular, we look for levels of tax-to-GDP around which we observe sharp changes in subsequent GDP growth rates. We interpret our findings as suggestive of the possible presence of multiple equilibria in tax compliance and capacity: small variations in tax levels around a tipping point can lead to economies jumping from one equilibrium to another. This in turn can lead to large differences in growth as some countries reach the high compliance/high

growth equilibrium while others remain in the low compliance/low growth equilibrium.

Our empirical methodology draws on Card, Mas, and Rothstein (2008) by following a two-step approach to estimate the location of a tipping point and its impact on subsequent growth. First, we regress cumulative real per capita GDP growth on tax-to-GDP levels. The location of the tipping point is determined by partitioning tax-to-GDP levels in two non-overlapping ranges and finding the value for which such a partition maximizes the fit of the regression. Second, we take the threshold value as if it were known and estimate the impact of crossing the tipping point on growth. We estimate the effect of the threshold by taking the difference in average cumulative growth rates for countries that are just to the left and just to the right of the threshold. This enables us to measure the effect on real GDP growth of a representative country that "crosses" the threshold. We also document that the effect on growth is robust to the inclusion of a number of additional covariates and fixed effects.

We rely on two independent databases for our analysis: a contemporary database and a historical database. The contemporary database assembles a large unbalanced panel consisting of tax-to-GDP and real GDP per capita for 139 countries from 1965 to 2011. The historical database is also an unbalanced panel consisting of tax-to-GDP ratios and real GDP per capita for 30 advanced countries between 1800 and 1980.

Using the contemporary dataset we find, from the first step in our procedure, that partitioning the range of values of tax-to-GDP levels in our sample around 12.88 of GDP provides the best fit across all horizons considered (Figure 1). The tipping point using cumulative GDP growth over 3, 5, 7 and 10 years are very similar, statistically significant and tightly estimated. The second step of our approach is illustrated in Figure 2. The figure shows clearly the effect of the threshold at the point of discontinuity around 12.88 percent of GDP: countries that are immediately to the left of the tipping point on average grow by around 20 to 25 percent in real terms over 10 years, or around 2 percent annually. Countries immediately to the right of the threshold grow by more than 30 percent over 10 years, or 2.8 percent annually. This implies that a country just above the threshold will have real GDP *per capita* around 7.5 percent larger, after 10 years, than an otherwise similar country just below it. This effect is tightly estimated and economically large.

The scatter plot shows average GDP growth in 0.5-percentage-point bins. The solid line is a local linear regression fit separately on either side of 12.88 using an Epanechnikov

Figure 1. Searching for a Tax Tipping Point at Different Horizons

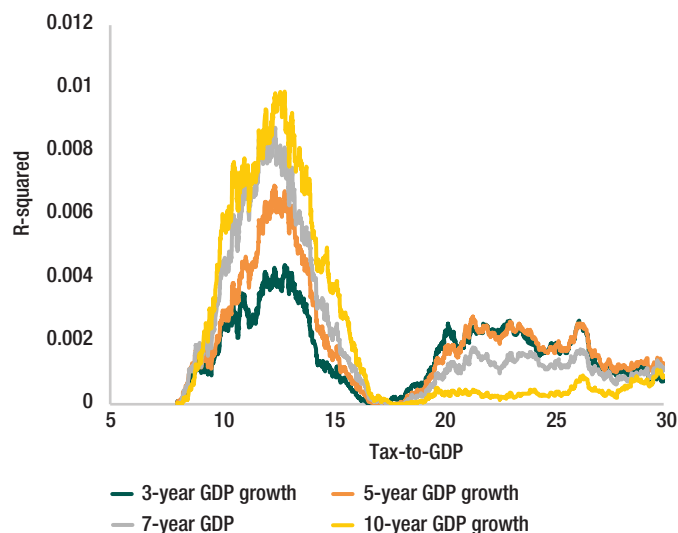
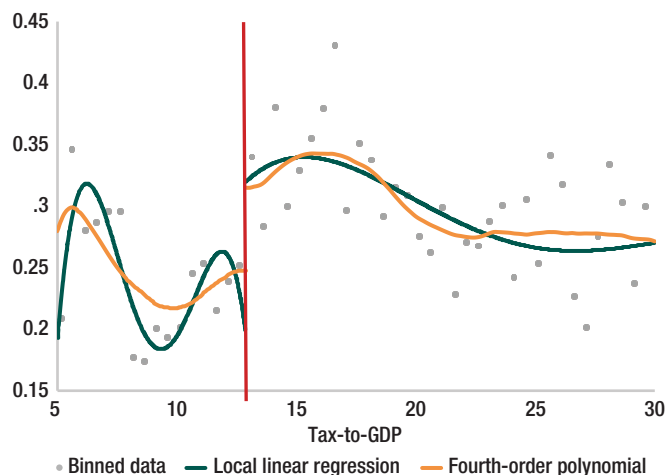


Figure 2. Impact of the Tax Threshold on 10-Year Cumulative Growth



kernel and a bandwidth of 1.5. The dashed line is a global fourth order polynomial estimated separately on either side of the tipping point.

We also estimate the tipping point using the historical database. The historical dataset allows the estimation of the tipping point for advanced economies, as most of them were already above the estimated threshold in 1965, when the contemporary database starts. Remarkably, from the first step, we find a statistically significant threshold in government tax revenue at 12.65 percent of GDP, very close to our result using contemporary data. The tipping point is also tightly estimated. The threshold impact on subsequent growth is also economically relevant, although not statistically significant, once time and country fixed effects are introduced.

Hence our answer to the initial question: “Is there a tipping point in the relation between tax capacity and growth?” is yes! Of particular note is that the tipping point occurs for both developing economies, in a contemporary dataset, as well as for advanced economies, in a historical dataset. These results raise the possibility that tax thresholds and tipping points are an inherent feature of the development of modern economies and the state and institutions that facilitate their emergence.

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U.S. Shale Revolution and Its Spillover Effects on the Global Economy

Ravi Balakrishnan, Keiko Honjo, Akito Matsumoto, and Andrea Pescatori



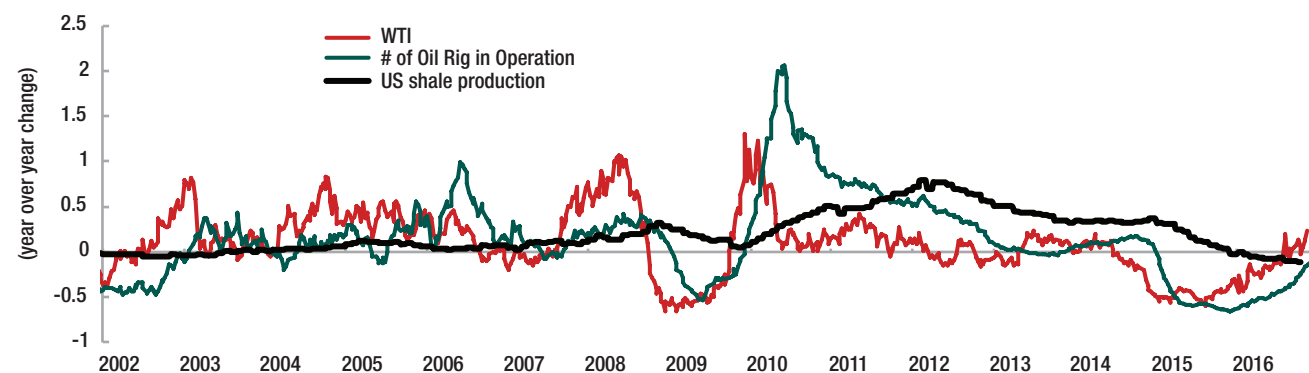
The U.S. oil industry experienced one of its most dramatic shifts in 2010–14, when a combination of high prices and technological change (notably horizontal drilling) led to a doubling of U.S. crude oil production. Both the number and productivity of rigs increased, with important implications for the oil market and the global economy more broadly. Following the 2014–15 oil price collapse, there has been active debate about the ability of the U.S. oil industry to absorb the shock and reequilibrate the global oil market. An important piece of this puzzle is understanding whether the shale industry can sustain its past exponential productivity increases. This note proposes three scenarios for shale production and draws out the spillover implications for some major oil importers and exporters.

The advent of shale oil production has added about 5 million barrels a day (mbd) to the crude oil market, contributing to a global supply glut. U.S. petroleum production accounted for 60 percent of world petroleum supply growth from 2011 to 2015. The supply glut is a key factor behind the dramatic decline in oil prices starting in mid-2014, from \$108 a barrel to less than \$30 in early 2016. Changes in

the strategic behavior of the Organization of the Petroleum Exporting Countries (OPEC) in November 2014 and the projected increase in Iranian exports were also important factors behind the glut. In recent meetings in September and November 2016, OPEC changed its strategy again to cut production in order to stabilize prices. However, the targeted production, 32.5 mbd, is only 1.2 mbd lower than its highest level of production. In addition, OPEC members have tended to produce more than their quota in the past, which calls the credibility of the production cut into question. On the demand side, downward revisions of global growth, especially in emerging markets, added downward price pressures—as did the turmoil in financial markets and the strong dollar. Looking ahead, the secular drop in petroleum consumption in advanced economies and scaled-down potential growth for emerging markets point to modest growth for oil demand.

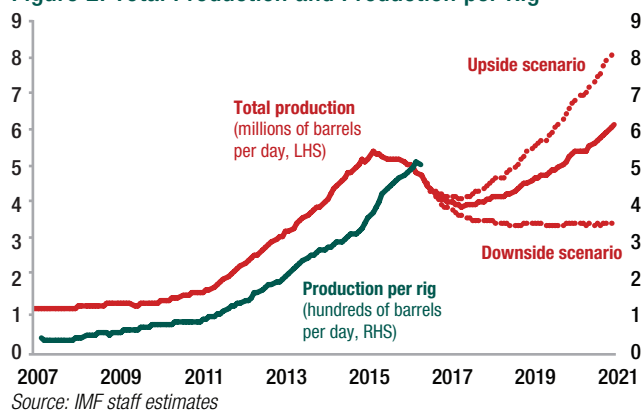
In this context, it is important to assess the resilience of shale oil production to low oil prices. U.S. shale oil production has been fairly resilient overall, in spite of low oil prices, thanks to continued phenomenal efficiency gains,

Figure 1. United States: Oil Price and Weekly Rig Count



Source: Baker Hughes, Energy Information Administration, and Datastream

Figure 2. Total Production and Production per Rig



some of which correspond to cost deflation induced by the same big drop in oil prices. Specifically: (1) Shale is still at a relatively early stage of its industry life cycle, so there is substantial scope for technological progress. (2) Declining upstream investment has forced the oil service industry to cut prices (by squeezing margins) for activities such as renting a rig or building pipelines. With significant cost deflation for oil service products, the breakeven cost of shale production has declined. As a result, despite dramatically lower investment (Figure 1), shale production has declined slowly, and much less than expected, and is today only 10 percent below its peak.

Prospects for the U.S. shale industry will affect the path of oil price recovery. On the one hand, shale production can be stepped up fairly rapidly so long as oil prices remain above shale field breakeven prices, which have on average dropped from about US\$60 to US\$40 a barrel given operational efficiency gains. Most likely, shale oil production will lead to shorter and more limited oil price cycles since it entails fewer sunk costs than conventional oil, and the lag between investment and production is much shorter. That feature of shale oil will limit the medium-term upward swing in oil prices. On the other hand, although shale oil production has been resilient, many shale oil companies are not in good financial shape. In particular, the wave of bankruptcies and layoffs in the shale oil industry over the past couple of years could slow any recovery in shale oil production. Skilled labor may be more difficult to mobilize swiftly. In addition, the cost discount from the oil service industry is likely to diminish once prices go back up, and the cost of capital may increase as long-term U.S. Treasury yields rise. Thus, breakeven prices could increase moderately with oil prices despite continued productivity improvements. In the next section, using a gen-

Figure 3. Upside Scenario Real GDP, 2021 (% diff.)



eral equilibrium global model of the oil market, we trace out the macroeconomic implications of various scenarios around the potential efficiency gains in the shale oil industry.

Scenario Analysis

The scenario uses the IMF's G20MOD model to trace out the global macroeconomic implications of the sustained role of the shale oil industry in oil prices and its spillover effects. We add two alternative scenarios around the baseline regarding U.S. shale oil production to capture uncertainty around U.S. shale oil production levels.

- **Baseline**—Draws on the prediction of a future rig count consistent with the current medium-term West Texas Intermediate crude oil forecast in the October 2016 IMF *World Economic Outlook* and assumes a linear improvement in productivity;
- **Upside**—Assumes a similar rig count to that in the baseline but with a quadratic upward trend for productivity per rig;
- **Downside**—Assumes decreasing gains in productivity (that is, uses a concave trend) and lowers the estimated impact of the West Texas Intermediate crude oil price on the rig count by one standard deviation (Figure 2).

The differential impact on production from these modest changes in assumptions is large. By 2020, U.S. production could range from 3.5 to 8.4 million barrels a day depending on the scenario (the baseline scenario is very similar to the one in the U.S. Energy Information Administration's latest forecast). The uncertainty regarding U.S. production is more significant than the OPEC oil production cut (1.2 mbd) announced in November, although this is a rather long-term projection. If

the upside scenario materializes, the positive effect would be large, because this would be a windfall gain for the United States. Net oil imports would decline, which would reduce the current account deficit. On the other hand, oil producers outside the United States could suffer. We will evaluate the effect using our model.

Global Spillovers

These shale oil scenarios are found to have the following effects:

- There are relatively symmetric effects in the upside and downside scenarios, with the decline in global oil prices in the upside scenario leading to an increase in global GDP of about 0.4 percent.
- The biggest winners in an upside production scenario are India and Korea, which import a large amount of oil and whose oil intensity is high. The most negative effects are on Saudi Arabia and Russia, which are highly dependent on oil and have limited trade links with the United States.
- Despite the significant oil price decline in the upside scenario, Canada and Mexico (which are oil exporters) receive a marginally positive short-term impact on GDP because of their strong trade links with the United States. However, these effects turn moderately negative by 2021 (Figure 3).

In conclusion, the U.S. oil industry has proved resilient to the oil price shock thanks to efficiency gains and cost deflation. Despite widespread uncertainty regarding the extent to which continued technological progress in the shale oil industry can further reduce breakeven costs, our scenarios suggest that the U.S. shale oil industry, all else equal, can put downward pressure on oil prices, which will contribute to sustained global growth—but at the cost of redistributing income from oil exporting to oil importing countries.



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Seven Questions about the Relationship between Country Finance and Governance

Amadou N.R. Sy and Mariama Sow, Africa Growth Initiative, Brookings Institution



Economists have studied the relationship between the quality of institutions and growth extensively (North 1990). In contrast, the relationship between the quality of institu-

tions and financial flows has been studied less. Because low-income countries depend heavily on external financing flows and are trying to strengthen domestic revenue mobilization, it is useful to look at the relationship between good governance and financial flows—in particular foreign direct investment, official development assistance, and tax revenue.

Question 1. Why is it important to assess the relationship between country finance and governance?

The Addis Ababa Action Agenda identifies financing for development, including domestic revenue mobilization, as central to achieving the United Nations sustainable development goals (SDGs) (UN 2015). At the same time, the process leading to the development of the SDGs has emphasized good governance as a priority. One of the SDGs (Goal 16) is dedicated solely to the “[promotion] of peaceful and inclusive societies for sustainable development, [the provision] of access to justice for all and [building] effective, accountable and inclusive institutions at all levels.” Bridging the gap and establishing the relationship between these two global priorities—financing for development and good governance—could yield useful policy recommendations for low-income and donor countries.

Question 2. How is good governance defined and measured?

Although it is widely used and promoted, stakeholders interpret “good governance” differently. The IMF defines it as “the management of government in a manner that is essentially free of abuse and corruption, and with due regard for the rule of law.” When it comes to governance indicators, however, the World Bank World Governance Indicators (WGIs) have been used extensively in empirical studies, and their advantages and limitations are well documented (Kaufmann, Kraay, and Mastruzzi 2010).

The six WGIs reflect three aspects of governance. The first is the process by which governments are selected, monitored, and replaced, which is captured by *voice and accountability* and *political stability* indicators. The second aspect is the capacity of government to effectively formulate sound policies, measured by *government effectiveness* and *regulatory quality* indicators. The third aspect is the respect of citizens and the state for the institutions that govern their economic and social interactions, which are proxied by *rule of law* and *control of corruption* indicators.

A possible limitation of the WGIs is that they are perception-based measures of governance. A 2009 paper by Benjamin Olken studies the accuracy of perception-based indices by comparing the perception of corruption with an objective measure of “missing expenditures” in relation to a road-building project in Indonesia. The author finds a positive correlation between perceived corruption and missing expenditures. Still, the author warns against using the two measures interchangeably.

However, Kaufmann, Kraay, and Mastruzzi (2010) argue that perception is important because it is the basis for action. For example, if investors perceive a country to be corrupt, they might refrain from investing there. Thus, a qualitative perception of governance could result in actual losses. In addition, there are a few alternatives to perception indicators. For instance, as Kaufmann, Kraay, and Mastruzzi (2010) point out, corruption, by definition, does not leave a paper trail and cannot be assessed solely through objective means.

Question 3. Is there reverse causality?

When studying the relationship between governance and financial flows, it is important to control for reverse causality. Better governance may have an effect on financial flows, but financial flows may also have an impact on governance. Most studies follow Acemoglu, Johnson, and Robinson (2001) and use settler mortality as an instrument to gauge governance. The authors argue that the quality of current institutions is highly correlated with European colonizers’ mortality.

Read more on page 8

Seven Questions

(continued from page 7)

In places where settler mortality was low, Europeans physically settled and created “good” institutions. Conversely, in places with high settler mortality, Europeans did not physically settle and were more likely to set up extractive institutions. The authors use settler mortality as an instrument for current institutions and find a large effect of institutions on income per capita. Using the same approach, we also find that settler mortality is a significant instrument of governance, in particular the control of corruption indicator.

Question 4. What is the relationship between governance and tax revenue?

A 2008 paper by Bird, Martinez-Vasquez, and Torgler looks at the effect of corruption and voice and accountability on tax efforts in developing and high-income economies. The paper states that supply-side factors—for example, an abundance of natural resources—can significantly improve tax efforts. However, demand-side factors, such as corruption, voice, and accountability, also significantly determine the effectiveness of tax efforts.

In a recent paper looking at costs and mitigating strategies, the IMF staff studies the link between corruption and tax revenue and finds that corruption significantly affects tax revenue as a share of GDP. Specifically, the study finds that a one standard deviation improvement in the corruption perception index leads to a 0.88 percentage point increase in tax revenue as a percentage of GDP. The paper lists several reasons for a continued negative link between corruption and taxation. For instance, corruption can fuel a government official’s ability to provide tax cuts to corporations, which can reduce taxpayers’ willingness to pay taxes. If large companies are perceived as not paying their fair share, taxpayers may balk at complying with tax laws (IMF 2016).

Using data on sub-Saharan African countries, we also find that governance indicators (in particular, control of corruption and voice and accountability) are positively and significantly related to tax revenue (Sy and Sow 2016).

Question 5. What is the relationship between governance and foreign direct investment?

A number of empirical studies have found that good governance has a positive effect on foreign direct investment. Alfaro, Kalemli-Ozcan, and Volosovych (2008) find that

poor institutional quality between 1970 and 2000 is the leading explanation for the difference in capital inflows between rich and poor countries. To put the effect in perspective, the paper states that if Peru’s institutional quality rose to Australia’s level, foreign investment would increase fourfold. In addition, the paper argues that foreign investment is the channel through which institutional quality affects long-term development. The paper suggests that in the interest of increased capital inflows, governments should strive to improve stability and property rights, reduce corruption, and increase law and order (Alfaro, Kalemli-Ozcan, and Volosovych 2008).

Faria and Mauro (2009) find that the external capital structure of countries—that is, the relative share of foreign direct investment, portfolio equity, and external debt in a country’s external financing—depends greatly on institutional quality. Although other factors—such as educational attainment, openness, and natural resource wealth—are important, institutional quality is the strongest determinant of a country’s external capital structure. The paper notes that measures that aim to improve a country’s capital structure should be evaluated carefully as they are sometimes undermined by poor institutional quality.

Conversely, other scholars have found a negative association between good governance and foreign investment. Ezeoha and Cattaneo (2012) find that corruption has a positive effect on foreign direct investment, and it is higher in resource-rich countries. Peter Egger and Hannes Winner (2005b) state that corruption can attract foreign investment as it “greases the wheels [...] in the presence of preexisting government failures.” Nevertheless, the authors find that the pull effect of corruption on foreign direct investment is declining as other factors, such as market size, rise in importance (Egger and Winner 2005a).

Focusing on African countries, we do not find a strong relationship between governance and foreign direct investment as a percentage of GDP. Interestingly, we find a positive relationship between the control of corruption indicator and foreign investment after two years, which suggests that although there is no immediate effect, there is a delayed pull effect on inflows of foreign direct investment. In addition, when we use the aggregate stock of inward FDI as the dependent variable, we find that FDI negatively responds to improved governance scores. In other words, sub-Saharan African countries with poor governance scores have the highest stock of FDI.

Question 6. What is the relationship between governance and official development assistance?

There are two channels through which governance can affect aid. First, good governance can help countries meet donors' good governance conditions, which allows them to receive aid. Second, poor governance can negatively affect growth prospects. In this scenario, we would witness a negative relationship between governance and aid, which is often allocated to countries with relatively low income.

Alesina and Weder (1999) do not find a positive effect of governance on aid inflows. Actually, their study finds that corrupt governments receive higher amounts of aid. Conversely, Akramov (2012) finds that the quality of governance affects the likelihood of eligibility for aid. All else equal, the author finds, poorly governed countries are less likely to receive aid than well governed countries. As expected, the analysis also finds that recipient needs—as measured through income per capita and life expectancy—also significantly determine aid inflows.

But does aid perform better in countries with good governance? A 2000 paper by David Dollar and Craig Burnside finds that aid is most effective in countries with good fiscal, monetary, and trade policies. Conversely, in the presence of poor policies, aid has little effect on growth. A more recent study by Denizer, Kaufmann, and Kraay (2013) examines the effectiveness of World Bank-funded projects and finds that over the past 25 years, these projects have performed better in well-governed countries. Although aid may flow to poorly governed countries—as these countries often fall in the low-income-country category—it does more good in well-governed countries.

Focusing on African countries, we find that governance indicators (except *political stability* and *rule of law*) are significantly and positively correlated with official development assistance. In other words, when we control for income levels, development assistance is allocated to relatively well-governed countries

Question 7. How is the literature relevant to policy?

Comparing the results above, we find that in Africa, good governance is better at mobilizing domestic resources than attracting external flows. Although tax revenues react positively to improved governance, the same cannot be assumed when it comes to foreign direct investment. One-third of foreign investment in Africa is directed to oil exporters, which typically have poor governance scores. For countries in the region, we find a negative relationship between good governance and natural

resource rents as a percentage of GDP. Many international organizations and bilateral donors have incorporated a good governance condition as part of their lending programs, which could explain the positive effect of governance on official development assistance (after controlling for GDP per capita).

Our results suggest that better governance should raise more financing for development, but not all types of financing flows. Domestic revenue responds well to improved governance, but the evidence appears to be mixed for external financing. The relatively strong association between good governance and domestic financing sources compared with external financing sources is also significant, because domestic revenue is the largest source of development finance for sub-Saharan countries. (As a share of GDP, taxes are larger than official development assistance and foreign direct investment). A domestic policy agenda to improve governance has the potential, therefore, to yield large dividends in terms of financing for development.

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Seven Questions

(continued from page 9)

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Conference Call for Papers, Submission Deadline: March 15, 2017

Threats to Globalization in the Aftermath of the Crisis

The Bank Negara Malaysia (BNM), the International Monetary Fund (IMF), and the *IMF Economic Review* are inviting paper submissions for a conference on “Threats to Globalization in the Aftermath of the Crisis” to be held at the Bank Negara Malaysia in Kuala Lumpur, July 25–26, 2017.

The conference will seek research on: (i) the recent past and medium-term future of international trade; (ii) the impact of protectionism and financial market turbulence on trade; and (iii) the labor market impact of both international trade and migration. We welcome submissions that focus on advanced economies, emerging economies, and Asia-Pacific economies. We are particularly interested in papers that address the following topics and questions:

- **The global slowdown in trade and finance.** What are the causes of the current trade slowdown? Is there a capital flow slowdown? Are there large secular changes in the composition of capital flows? Has the relationship between real synchronization and financial integration changed?
- **Trade consequences of “secular stagnation” and protractedly low external demand.** Is there a missing generation of exporters? What are the implications for selection into exporting and medium-run trade dynamics?
- **Protectionism, income inequality, and globalization.** Does higher inequality lead to more demand for protectionism? How does higher inequality affect international asset markets? What is the effect of protectionism on global supply chains? What policies can ensure that the gains from globalization are spread more evenly?
- **Trade implications of asset market dynamics.** What are the implications for domestic and export market entry of financial frictions and shocks? How does international market liquidity affect goods trade? How do multinational and trade links affect stock market comovements across countries?
- **Migration, remittances and welfare.** What is the impact of immigration on labor markets in recipient countries? How does emigration affect remittances and inequality in origin countries?

Please send submissions in Adobe PDF format to: BNMIMFER2017@IMF.ORG. Selected papers will be considered for publication in a **special issue** of the *IMF Economic Review*. Please indicate whether you want to contribute to this issue when you send your submission. (Also, submissions that are not being submitted to the *IMF Economic Review* are welcome).

Deadline for paper submissions is March 15, 2017 (authors of accepted papers will be informed by April 15, 2017). Preference will be given to submissions of finished papers. The conference will fund travel and local accommodation for speakers and discussants.

IMF Working Papers

Working Paper 16/172

Negative Interest Rate Policy (NIRP): Implications for Monetary Transmission and Bank Profitability in the Euro Area

Andreas Jobst, Huidan Lin

Working Paper 16/173

China's Growing Influence on Asian Financial Markets

Serkan Arslanalp, Wei Liao, Shi Piao, Dulani Seneviratne

Working Paper 16/174

Aggregate Uncertainty and Sectoral Productivity Growth: The Role of Credit Constraints

Sangyup Choi, Davide Furceri, Yi Huang, Prakash Loungani

Working Paper 16/175

Profitability and Balance Sheet Repair of Italian Banks

Andreas Jobst, Anke Weber

Working Paper 16/176

Growing Apart, Losing Trust? The Impact of Inequality on Social Capital

Eric D. Gould, Alexander Hijzen

Working Paper 16/178

Optimal Debt Policy Under Asymmetric Risk

Julio Escolano, Vitor Gaspar

Working Paper 16/179

Smoke Screen: Estimating the Tax Pass-Through to Cigarette Prices in Pakistan

Serhan Cevik

Working Paper 16/180

Market Frictions, Interbank Linkages and Excessive Interconnections

Pragyan Deb

Working Paper 16/181

China's Financial Interlinkages and Implications for Inter-Agency Coordination

Min Liao, Tao Sun, Jinfan Zhang

Working Paper 16/182

Unlocking Pakistan's Revenue Potential

Serhan Cevik

Working Paper 16/183

Rebalancing in China—Progress and Prospects

Longmei Zhang

Working Paper 16/184

Spatial Dependence and Data-Driven Networks of International Banks

Ben Craig, Martín Saldías

Working Paper 16/185

Highways to Heaven: Infrastructure Determinants and Trends in Latin America and the Caribbean

Valerie Cerra, Alfredo Cuevas, Carlos Góes, Izabela Karpowicz, Troy D Matheson, Issouf Samaké, Svetlana Vtyurina

Working Paper 16/186

Supervisory Incentives in a Banking Union

Elena Carletti, Giovanni Dell'Ariccia, Robert Marquez

Working Paper 16/187

Regulating Local Government Financing Vehicles and Public-Private Partnerships in China

Hui Jin, Isabel Rial

Working Paper 16/188

Fiscal Rules for Resource Windfall Allocation: The Case of Trinidad and Tobago

Keyra Primus

Working Paper 16/189

The Effectiveness of Monetary Policy in Small Open Economies: An Empirical Investigation

Keyra Primus

Working Paper 16/190

Fragmented Politics and Public Debt

Ernesto Crivelli, Sanjeev Gupta, Carlos Mulas-Granados, Carolina Correa-Caro

Working Paper 16/191

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Ana Lariau, Moataz El-Said, Misa Takebe

Working Paper 16/192

How to Improve Inflation Targeting in Canada

Maurice Obstfeld, Kevin Clinton, Ondra Kamenik, Douglas Laxton, Yulia Ustyugova, Hou Wang

Working Paper 16/193

Products and Provinces: A Disaggregated Panel Analysis of Canada's Manufacturing Exports

Itai Agur

Working Paper 16/194

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Ikuo Saito

Working Paper 16/195

U.S. Monetary Policy Normalization and Global Interest Rates

Carlos Caceres, Yan Carriere-Swallow, Ishak Demir, Bertrand Gruss

Read more on page 12

IMF Working Papers

(continued from page 11)

Working Paper 16/196

Is Capping Executive Bonuses Useful?

Kentaro Asai

Working Paper 16/197

Central Banking in Latin America: The Way Forward

Yan Carriere-Swallow, Luis I. Jacome H., Nicolas E Magud, Alejandro M. Werner

Working Paper 16/198

Negative Interest Rates: How Big a Challenge for Large Danish and Swedish Banks?

Rima Turk

Working Paper 16/199

Gone with the Wind: Estimating Hurricane and Climate Change Costs in the Caribbean

Sebastian Acevedo Mejia

Working Paper 16/200

Assessing Liquidity Buffers in the Panamanian Banking Sector

Andras Komaromi, Metodij Hadzi-Vaskov, Torsten Wezel

Working Paper 16/201

Estimating Potential Output in Chile: A Multivariate Filter for Mining and Non-Mining Sectors

Patrick Blagrove, Marika Santoro

Working Paper 16/202

The Blind Side of Public Debt Spikes

Laura Jaramillo, Carlos Mulas-Granados, Elijah Kimani

Working Paper 16/203

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Wojciech Maliszewski, Serkan Arslanalp, John Caparusso, José Garrido, Si Guo, Joong Shik Kang, W. Raphael Lam, Daniel Law, Wei Liao, Nadia Rendak, Philippe Wingender, Jiangyan Yu, Longmei Zhang

Working Paper 16/204

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Jae Chung, Lev Ratnovski

Working Paper 16/205

Surprise, Surprise: What Drives the Rand / U.S. Dollar Exchange Rate Volatility?

Nasha Maveé, Roberto Perrelli, Axel Schimmelpfennig

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Koffie Ben Nassar, Joel Chiedu Okwuokei, Mike Li, Timothy Robinson, Saji Thomas

Working Paper 16/207

The Role of Newly Industrialized Economies in Global Value Chains

Dominik Boddin

Working Paper 16/208

Dominican Republic: Sectoral Financial Positions and Macroeconomic Vulnerabilities

Svetlana Cerovic, Jose Saboin

Working Paper 16/209

Can Statistical Capacity Building Help Reduce Procyclical Fiscal Policy in Developing Countries?

Sam pawende J. Tapsoba, Robert C. York, Neree C.G.M. Noumon

Working Paper 16/210

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Kamiar Mohaddes, M. Hashem Pesaran

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Nir Klein

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Allan Dizioli, Benjamin L. Hunt, Wojciech Maliszewski

Working Paper 16/213

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Mick Silver

Working Paper 16/214

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Sohrab Rafiq

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Szilard Benk, Tamas Csabafi, Jing Dang, Max Gillman, Michal Kejak

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Tigran Poghosyan

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Working Paper 16/218

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Fabio Comelli, Esther Perez Ruiz

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Rui Mano

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Chie Aoyagi, Giovanni Ganelli, Nour Tawk

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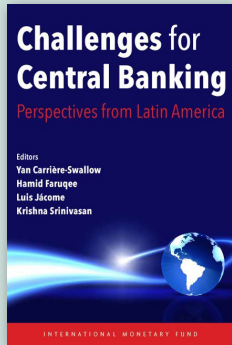
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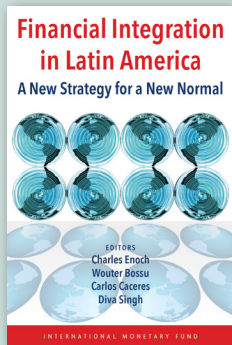
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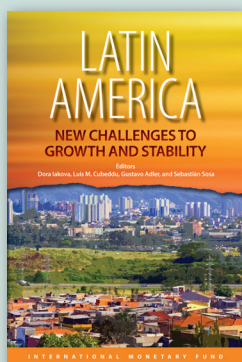
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No. 16/08

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Björn Rother, Gaëlle Pierre, Davide Lombardo, Risto Herrala, Priscilla Toffano, Erik Roos, Greg Auclair, and Karina Manasseh

No. 16/09

Macroeconomic Management When Policy Space Is Constrained: A Comprehensive, Consistent, and Coordinated Approach to Economic Policy

Vitor Gaspar, Maurice Obstfeld, and Ratna Sahay

Other authors: Douglas Laxton (Team Leader), Dennis Botman, Kevin Clinton, Romain Duval, Kotaro Ishi, Zoltan Jakab, Laura Jaramillo Mayor, Constant Lonkeng Nguouana, Tommaso Mancini Griffoli, Joannes Mongardini, Susanna Mursula, Erlend Nier, Yulia Ustyugova, Hou Wang, and Oliver Wuensch