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Rethinking the Macroeconomics of Resource-Rich Countries

Edited by Rabah Arezki, Raouf Boucekkine, Jeffrey Frankel, Mohammed Laksaci and Rick van der Ploeg

A VoxEU.org Book

CEPR Press

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Foreword

Trends in commodity prices, most notably oil, have changed remarkably in the last few years. After years of highs, lower prices now appear to be persisting. This fundamentally shifting landscape appears to be the result of a combination of supply-side innovations, such as fracking, as well as demand-side constraints that themselves are a consequence of faltering global economic growth. This eBook, which gathers together the proceedings from a conference in Algiers in May 2016, provides some important insights on the experience of resource-rich countries of these changes in commodity markets, with direct relevance for both academic researchers and policymakers.

Based on the understanding that the changes to oil prices are structural, the eBook recognises that policy responses have to be different from those employed in the past. The authors discuss in depth the ways that monetary, fiscal, and exchange rate policy options can be used to respond to these changes in oil prices. Short-term price declines can be hedged against with options contracts, while long-term risk can be counteracted with commodity-linked bonds. For resource-rich countries, one option is deploying oil and gas revenues to reduce their vulnerability to price crashes. The common thread running through this research is that these countries must develop a robust macroeconomic framework to respond to the collapse in commodity prices. Policymakers should also think differently about the role of finance and diversification in improving the resilience of their economies.

CEPR thanks Rabah Arezki, Raouf Boucekkine, Jeffrey Frankel, Mohamed Laksaci and Rick van der Ploeg for their editorship of this eBook, and Anil Shamdasani and Sophie Roughton for their significant efforts on its production. CEPR, which takes no institutional positions on economic policy matters, is glad to provide a platform for an exchange of views on this topic.

Tessa Ogden
Chief Executive Officer, CEPR
April 2018

1 Introduction

Rabah Arezki, Raouf Boucekkine, Jeffrey Frankel, Mohamed Laksaci and **Rick van der Ploeg**
World Bank; Aix-Marseille University; Harvard Kennedy School; Ecole Superieure de Commerce; University of Oxford and CEPR

Global commodity markets have been in upheaval in recent decades. Prices soared, then sank. Commodity producers and consumers alike felt the effects of these wide price swings. For oil, the world's most traded commodity, it seems unlikely that prices will return to the high levels prevailing when the historic collapse started in June 2014. For one thing, innovation in drilling has radically expanded the size of technically and economically recoverable reserves. For another, demand will be curtailed by slower growth in emerging markets and global efforts to reduce carbon emissions. It all adds up to a 'new normal' for oil and other commodities.

Navigating this new normal for commodity prices is challenging for resource-rich countries, which must cope with the decline in income that accompanies the lower prices. To limit the widening of (internal and external) imbalances caused by the lower prices, these countries must make short-run adjustments. They can use a combination of exchange rate and monetary and fiscal policies to do so. The recent collapse in commodity prices and its persistent nature has forced a relatively swift adjustment. Countries that built buffers, such as many Gulf Cooperation Council countries, were able to limit the pain by spreading the adjustment over time. Countries that had not built buffers had no choice but to adjust more abruptly by taking steps such as slashing spending, cutting imports, and/or raising taxes.

Whether the short-term adjustment was more or less painful, resource-rich countries must now face a second phase of adjustment: making structural changes to reduce resource dependence. The challenges over the medium run are enormous, especially considering how difficult it has been historically for these countries to diversify their economies. Moreover, new risks have emerged, such as stranded assets – fossil fuel

assets that will no longer earn an economic return because of declining demand caused mainly by global environmental concerns.

Synthesising research

This eBook is based on the proceedings of a conference held in Algiers, Algeria, on 28-29 May 2016. The conference, titled "Natural Resources, Finance and Growth," was sponsored by the Bank of Algeria. The contributions to this conference volume reflect the latest scholarship on the macroeconomics of resource richness, with a specific focus on lessons learned from the recent boom and bust in commodity prices.

The volume aims to synthesise the key insights that have emerged from the latest economic research on resource-rich countries, making them user-friendly for both policymakers and scholars. The contributions cover a wide range of issues, including economic developments in the oil market; monetary, exchange rate, and fiscal policies; as well as sovereign wealth funds, finance, and economic diversification. The common denominator for all the chapters is the need for countries to build and maintain a robust and resilient macroeconomic and financial framework in the wake of the collapse in commodity prices.

Another thread linking the chapters is the recognition that while countries have learned from the past and have been more prudent, there is a need to think differently about the role of finance and diversification in the transformation of these economies.

Both academic economists and practitioners from the public and private sectors have contributed to this volume. The chapters tackle the three main themes around which the book is organised: the shifting landscape in commodity markets, macroeconomic policy options, and finance and diversification.

Shifting landscape

Part One explores the role of technology in the commodity market collapse and its implications. Most studies have emphasised excess supply as the dominant factor in the 2014 oil price collapse. Because a sudden increase in supply – a seemingly exogenous

development – was the overarching reason for the drop, there should have been a strong positive impact on the global economy. So far, there has not been one. That may be, in part at least, because the increase in supply was not independent of the market, but due to powerful shifts in technology triggered by high prices.

Technological innovation, which led to the adoption of new recovery techniques, spawned the development of 'unconventional oil'. Oil produced from shale (also called 'tight oil'), for example, has become a major contributor to the global oil supply. Provided they are effective and widely adopted, improvements in recovery techniques increase the size of technically recoverable oil reserves. This increase, in turn, changes expectations about future oil production – with potentially large and immediate implications for oil prices.

Innovations in recovery techniques typically follow periods of prolonged high prices or changes in regulations that render the new techniques more economical. New oil sources often come on stream in times of need – because of, say, the depletion of existing conventional sources. They often occur in places that have economic and institutional systems more favourable to both innovation and the adoption of new recovery techniques, like the US and Canada. Innovation has led to significant improvements in drilling techniques, such as 3D imaging and hydraulic fracturing. Hydraulic fracturing, in which water is injected to free up petroleum trapped in layers of rock, gave rise to the large increase in production of shale oil in the 2000s.

Rabah Arezki of the World Bank argues for a rethink of developments in the oil market. Arguably, the oil market has changed structurally and the dynamic adjustment to lower oil prices is now quite different from those in the past. Specifically, the advent of hydraulic fracturing (dubbed 'fracking'), combined with horizontal drilling, led to the widespread production of 'shale oil', a development that changed the dynamic of the oil market. Indeed, shale oil will lead to shorter and more limited oil-price cycles. The resilience of shale production to the lower prices that it ushered in surprised market participants. That led to even lower prices in 2015. Shale drillers significantly cut costs by improving efficiency, which allowed major players to avoid bankruptcy. Shale oil production and the uncertainty surrounding its potential and resilience will define the dynamics of the oil market for years to come. In the long run, though, a broader energy

perspective is needed to comprehend the future of oil. The way falling oil prices affect the global economy has also changed importantly.

Macroeconomic policy options

Part Two discusses the options policymakers have during periods of commodity price fluctuations. Specifically, the second part explores the roles monetary, exchange rate, and fiscal policies should play in the adjustment to commodity terms of trade fluctuations.

Jeffrey Frankel of Harvard University's Kennedy School of Government proposes three ways commodity exporters can make themselves less vulnerable to the vagaries of commodity markets. First, they can use options contracts to hedge against short-term declines in the commodity price without giving up the benefits of price increases. Mexico has used options quite successfully. Second, commodity-linked bonds can hedge longer-term risk, and often have a natural counterparty in multinational corporations that depend on the commodity as an input. Third, insulating official forecasters again optimism bias can reduce the well-documented tendency of commodity exporters to engage in pro-cyclical fiscal policies (which enhance the direction of the business cycle by increasing spending in good times and decreasing it in recessions). Chile has pioneered this approach.

In his second chapter, Frankel discusses the optimal monetary regime for commodity-exporting developing countries. It is desirable to let the currency appreciate in response to positive terms of trade shocks and depreciate during negative shocks. But such a response is precluded if the exchange rate is fixed or if the monetary authorities hew rigidly to a CPI-targeted in conducting policy. Still, countries need some sort of nominal anchor. So, Frankel outlines how monetary policy can be made to respond automatically in a more counter-cyclical manner (judged by the appreciation or depreciation of the currency in response to terms-of-trade shocks). He identifies two regimes to achieve automatic counter-cyclicality: authorities can either add the export commodity to a currency basket, or target nominal income rather than the CPI.

Rick van der Ploeg of the University of Oxford notes that the resource-rich developing countries have a bad record in dealing with windfalls and price crashes. He calls for oil and gas revenue to be used to curb capital scarcity, invest domestically, and bring consumption forward. The real exchange rate also must temporarily appreciate to boost investment in the domestic economy and to efficiently absorb extra spending from a windfall. Furthermore, the timing of handing back the windfall to the private sector matters and consumption and the real exchange rate will be volatile. Finally, a Taylor rule, which links monetary policy to specific economic criteria, is a better short-run response to a crash in commodity prices than a policy that relies on a nominal exchange rate peg.

Ragnar Torvik, of the Norwegian University of Science and Technology, studies how monetary policy should respond to oil price shocks. If an oil price shock is temporary, then the issue is how to best smooth out economic fluctuations until normal times return. However, if the shock is more persistent, the policy requirements are more challenging. First, there is need to diversify the economy to make it less reliant on oil income. New or expanded non-oil industries can provide alternative sources of foreign exchange earnings (or, by replacing imports, allow the saving of foreign exchange). Second, a weakened fiscal position may make using taxes or spending to smooth the shock problematic. Torvik argues that when fiscal policy is constrained, monetary policy becomes an important tool in dealing with a permanent shock. It can set the economy on a path towards increased diversification and investment in traded sectors, while fiscal policy expansion may do the opposite.

Arezki, in a separate chapter, calls for a rethink of how monetary policy in fossil fuel exporters deals with short-, medium- and long-term horizons. The main argument is that central banks in these economies must look beyond the horizon of the business cycle. In the short run, (independent) monetary policy should flexibly target inflation. In the medium run, central banks need to coordinate with fiscal authorities to ensure monetary policy operates around a credible and sustainable fiscal anchor. In the long run, central banks should be aware of the existential threats posed by risks such as those related to stranded assets.

Finance and diversification

Structural policies to move away from resource dependence are explored in the third part of this volume. Particular attention is paid to the role that finance and sovereign wealth funds can play in supporting economic transformation.

Thorsten Beck of Cass Business School of the City University of London studies the link between finance and growth in resource-rich countries. The evidence so far is that financial development is as important for economic growth in resource-rich countries as in other countries and that there is a natural resource curse in financial sector development – resource-rich countries tend to be less financial developed everything else being equal. However, this is only a first step in what promises to be a rich research and policy agenda. First is the question of policies and institutions needed to overcome the natural resource curse in finance. Is it a question of ensuring that the necessary institutions for an effective and stable financial system are in place in resource-rich countries, or are additional steps necessary? A second important question is the extent to which recent regulatory reforms in finance have to be adjusted for resource-rich economies. Specifically, since 2008, there has been a significant push towards stronger capital requirements, the introduction of liquidity requirements, and an increasing role of macroprudential regulatory tools that seek to mitigate the risks to the financial system as a whole rather focusing on the health of individual institutions. Because of higher volatility in resource-related revenues and therefore in deposit and lending in developing economies, macro-prudential policies might be more important for resource-rich countries than others.

In his chapter, van der Ploeg argues that the orthodox advice for responding to an oil price crash is based on the permanent income hypothesis – that is, that consumption should be smoothed across generations by accumulating oil revenue into a sovereign wealth fund, which can be dipped into if there is a temporary drop in revenue, but not when the drop in revenue is permanent. In that case, spending should be cut or taxes raised. To cope with volatile commodity prices, precautionary buffers should be put in a stabilisation fund. No oil and gas revenue should be invested in the domestic economy unless the country has imperfect access to international capital markets. Revenue must then be used to reduce capital scarcity by investing domestically and by bringing

consumption forward. The revenue can then be parked temporarily in an investment fund.

Thorvaldur Gylfason of the University of Iceland describes economic diversification as one of several potential drivers of sustained economic growth. He argues that due consideration should be paid simultaneously to economic and political diversification. Political diversification is the democratisation of political processes that reduce the risks and vulnerabilities of excessive dependence on a narrow political base. Political diversification can be viewed as the twin sister of economic diversification, which reduces the reliance on a single industry.

Jean Imbs of the Paris School of Economics offers an explanation for why developing economies are notoriously more specialised than advanced economies. Over the course of development, poor countries diversify as the allocation of factors of production becomes increasingly uniform across sectors. The starting point is typically an economy specialised in primary goods or extractive activities. During the industrialisation process, a manufacturing sector emerges first, followed by others as manufacturing itself diversifies and factors are allocated more equally across industries. This chronology seems to characterise not only the economic miracles of the 20th and 21st century (such as Germany, Japan, Korea, China, among others), but also the Industrial Revolution that began more than a century earlier in continental Europe. A forensic analysis of the mechanics of diversification is a first order research question, with far-ranging policy implications. Imbs offers an explanation of diversification that is based not on an economy's integration with international markets, but rather on its integration with local markets. He argues that the emergence of a manufacturing sector in Africa is heavily hampered by the absence of local market access. Increasing returns to scale, for instance, means that that profitability increases when fixed costs of production can be spread over larger output. But when market size is reduced, constraining returns to scale, the costs of opening new activities often exceed their benefits. So specialisation in primary, agricultural sectors persists over time, as entrepreneurs do not find it worth their while to open up new sectors. International trade does not help, because it mostly creates incentives to serve the international market, which for Africa means commodity exports.

About the authors

Rabah Arezki is the Chief Economist for Middle East and North Africa Region (MNA) at the World Bank. Previously, Rabah Arezki was the Chief of the Commodities Unit in the Research Department at the International Monetary Fund. He is also a senior fellow at Harvard University's John F. Kennedy School of Government, a non-resident fellow at the Brookings Institution, an external research associate at the University of Oxford, a resource person for the African Economic Research Consortium and a research fellow at the Economic Research Forum.

Mr. Arezki is the author and co-author of numerous academic journal publications and other publications, including the *Quarterly Journal of Economics*, the *World Bank Economic Review,* the *Economic Journal,* the *Journal of International Economics*, the *Journal of Development Economics* and *Economic Policy*. Mr. Arezki's research covers a wide array of topics energy and the environment, the macro-development resource rich countries, institutions, human capital, innovation and economic growth.

Mr. Arezki is the co-editor, and co-author of four books including *Beyond the Curse: Policies to Harness the Power of Natural Resources, Commodity Price Volatility and Inclusive Growth in Low-Income Countries, Shifting Commodity Markets in a Globalized World*, and *Coping with the Climate Crisis: Mitigation Policies and Global Coordination* (forthcoming).

Many of Mr. Arezki's research papers have been cited extensively in academic circles and in prominent media outlets such as the *Economist,* the *Financial Times*, the *New York Times*, the *Wall Street Journal*, *Project Syndicate*, and the *Washington Post*. His blog posts including on the recent oil price collapse and its global economic consequences have been viewed over hundred thousand times and have been listed as the most read IMF blog posts three years in a row. Mr. Arezki is also a frequent contributor to *Finance and Development* magazine, VoxEU, an associate editor of the *Revue d'Economie du Développement* and was until recently the Editor of the *IMF Research Bulletin*.

A dual citizen of Algeria and France, Mr. Arezki received his M.S. from the Ecole Nationale de la Statistique et de l'Administration Economique in Paris, M.A. from the

University of Paris-1 Pantheon-Sorbonne and Ph.D. in economics from the European University Institute, Florence.

Raouf Boucekkine is a Professor of Economics at Aix-Marseille University, senior member of the Institut Universitaire de France, and Director General of IMéRA, the Institute for Advanced Study of Aix-Marseille University. He is also current President of ASSET (the Southern European Association of Economic Theorists) and deputy coordinator of the network UBIAS (University-Based Institutes for Advanced Study), including some of the top universities in the world. He has been professor and/or visiting professor in several European universities in Spain, United-Kingdom, France and Belgium, and director of several institutes and schools in these places (including the Center of Operations Research and Econometrics in Louvain, Belgium). He has published extensively in several areas of economics, operations research and mathematical demography. He is currently associate editor of several reputed journals including *Journal of Economic Dynamics & Control, Macroeconomic Dynamics, Journal of Public Economic Theory* and *Journal of Mathematical Economics*. He has also served as economic advisor to the Algerian Prime Minister Abdelmalek Sellal from 2015 to 2017. He has written opinions in several newspapers and media including *Le Monde* (France), *Les Echos* (France), *Le Soir* (Belgium), *El Watan* (Algeria) and *Liberté* (Algeria).

Jeffrey Frankel is Harpel Professor of Capital Formation and Growth at Harvard University's Kennedy School of Government. He is a Research Associate of the National Bureau of Economic Research, where he is also on the Business Cycle Dating Committee (which officially declares U.S. recessions) and co-chairs the International Seminar on Macroeconomics. Professor Frankel served at the US President's Council of Economic Advisers in 1983-84 and 1996-99; he was appointed by Bill Clinton as CEA Member with responsibility for macroeconomics, international economics, and the environment.

Before moving east, he had been Professor of Economics at the University of California, Berkeley, having joined the faculty in 1979. In the past he has visited the IMF, the Federal Reserve Board, and the Peterson Institute for International Economics. His research interests include currencies, crises, commodities, international finance, monetary and fiscal policy, trade, and global environmental issues. He was born in San

Francisco, graduated from Swarthmore College, and received his Economics PhD from MIT.

Mohammed Laksaci graduated from Algiers's Ecole Superieure de Commerce in 1978 with a bachelor degree in finance. He holds a bachelor's and a master's degree in economics from the Catholic University of Louvain (UCL, Belgium). In 1985, he received his PhD in economics from UCLouvain, where he also worked as a teaching assistant from 1982 to 1985 in charge of the Monetary Theory course. From 1986 to 1990, he was a lecturer at Algiers's Ecole Superieure de Commerce and president of its scientific council.

He became the head of the research department at Bank of Algeria in 1990 where he was also in charge of the relations with the International Monetary Fund and the World Bank, a period marked by the implementation of two stabilization programs (1991 and 1994) and an EFF program (1995-1998). In 1997, he was appointed Vice-Governor of that institution and served until early June 2001. On June 02, 2001, he was appointed Governor of the Bank of Algeria and started his 15-year term, during which he was president of the monetary and credit council and of the banking commission.

From 2001 to 2016, he was Governor at the International Monetary Fund for Algeria, and a member of its international monetary and financial committee representing a group of six countries : Afghanistan, Algeria, Ghana, Iran, Morocco and Tunisia. During that period, he also served as Vice-Governor at the Arab Monetary Fund. Laksaci was nominated president of the Association of African Central Banks twice.

Since November 2016, he is a visiting lecturer at Ecole Superieure de Commerce, dispensing courses for PhD students.

Rick van der Ploeg is Professor of Economics at the University of Oxford, having previously been an academic at the University of Cambridge (1977-1983), London School of Economics (1983-1988), Tilburg University (1985-1991) and the European University Institute, Florence (1988, 2003-7), a Chief Financial Spokesperson in the Dutch Parliament (1994-98), a State Secretary for Education, Culture and Science (1998-2002) and an elected member of the UNESCO World Heritage Committee (2003-7). He is also affiliated with CEPR, CESifo, Oxcarre, Netspar, VU University of Amsterdam, and the Tinbergen Institute.

Although most of his work has been on macroeconomics and public finance, he currently works on the economics of natural resources with side interests in higher education reform and economics of art and culture. He earned his Ph.D. in Engineering from the University of Cambridge and is editor of the Basil Blackwell *Handbook of International Macroecomics*, co-author of the OUP textbook *Foundations of Modern Macroeconomics,* and author of numerous articles in academic journals and the popular press.

PART I

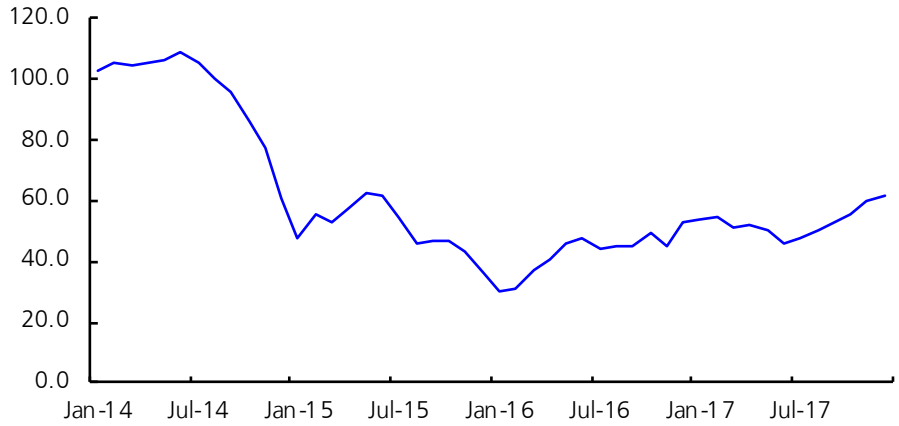
Shifting Landscape

2 Rethinking the oil market in the aftermath of the recent price slump

Rabah Arezki
World Bank

Oil prices have decreased by about 50% compared to their recent peak in June 2014 (see Figure 1). This dramatic (and largely unexpected) development has sparked intense debates over its causes and consequences. Arguably, the oil market has changed structurally, and the dynamic adjustment to lower oil prices is now quite different from the past.

Figure 1 The 2014-2016 oil price slump



Source: IMF, Primary Commodity Price System.
Note: APSP = average petroleum spot price—average of U.K. Brent, Dubai, and West Texas Intermediate, equally weighted.

Specifically, the advent of hydraulic fracturing combined with horizontal drilling has led to the advent of 'shale oil,' which has changed the dynamic of the oil market. Indeed, shale oil will lead to shorter and more limited oil price cycles. The rapid increase in the

production of shale oil – to the tune of 5 million barrels a day (mbd) in a market of 94 mbd – has also arguably contributed to the oil supply glut which led to the collapse in oil prices that started in June 2014.

Although the price collapse led to a massive cut in oil investment, production was slow to respond, keeping supply in excess. The resilience of shale production to lower prices surprised market participants, leading to even lower prices in 2015. Shale drillers significantly cut costs by improving efficiency, allowing major players to avoid bankruptcy. Shale oil production and the uncertainty surrounding its potential and resilience will define the dynamics of the oil market for years to come.

In the long run, a broader energy perspective is needed to comprehend the future of oil. The way falling oil prices affect the global economy has also changed importantly. This chapter provides brief answers to seven questions about the oil market in the global economy.

Question 1. Is the slump attributable to a 'supply glut' or to 'peak demand'?

The evidence suggests that supply factors have been more potent than demand factors in explaining the initial collapse in oil prices in 2014. A host of factors are involved including the rapid increase in shale production in the US, the change in strategy on the part of Saudi Arabia (the largest member of the Organization of Petroleum Exporting Countries, or OPEC), and the higher than expected output in some locals in spite of ongoing conflicts (e.g. Libya and Iraq), the return of Iranian oil to international markets, the US removal of the oil export ban, and so on. These factors have persisted. The dynamic adjustment of investment in the oil sector to lower prices is shaping, and will continue to shape, the speed and extent of any market recovery.

Demand factors have also played an important role. However, oil demand has grown unabated since 2011, the starting date of the emerging market growth slowdown. Of course, changes in expectations about future oil demand may also explain the delayed market response. Specifically, the realisation that the emerging market slowdown is structural as opposed to cyclical has been gradual. Several episodes of market scare

when oil prices collapsed further before rebounding – the end of August 2015 and January to February 2016 – suggest that financial factors are also relevant.

Question 2. Does OPEC (still) matter?

In theory, the effectiveness of a cartel and its compact depend on the strength of demand and supply outside the cartel. The 2000 era has been characterised by strong demand and a relatively strong OPEC that, in turn, enticed investment and production in high cost locals (for example, oil sand in Canada and ultra-deep water oil in Brazil). Considering the delay between investment and production for (conventional) oil, production in non-OPEC locals peaked about the same time as emerging markets started to slow down and when expectations about future demand began to falter.

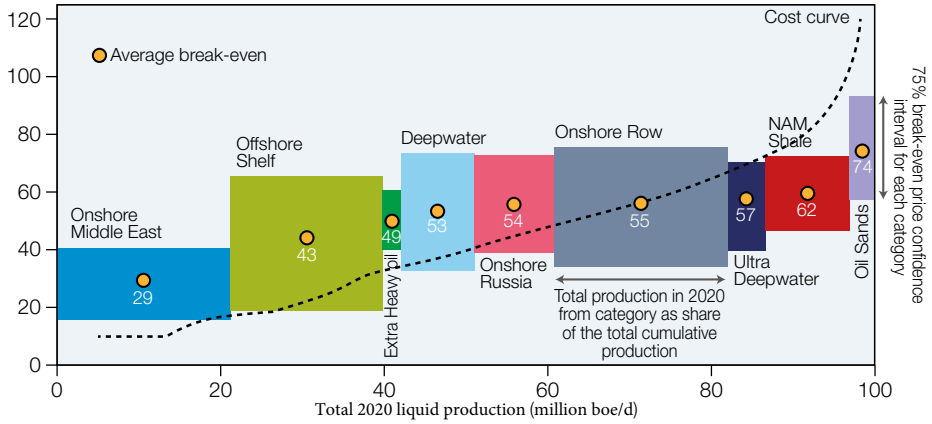
These circumstances sparked a change in strategy on the part of OPEC's dominant producer and also lowest-cost producer. In the past, Saudi Arabia would stabilise prices by cutting production whenever prices fell by too much, or raising production when prices rose too high relative to a stated price target. In 1986, Saudi Arabia attempted to cut production by an unprecedented margin when non-OPEC production also rose rapidly. That cut in production was intended to help support oil prices, but was unsuccessful. Perhaps learning from the 1986 episode, Saudi Arabia did not attempt to cut production this time around. Instead, it announced that it would go ahead and step up production effectively crowding out high cost producers.

While observers had expected the initial change in strategy to last in order for it to be successful, on 30 November OPEC agreed to reduce crude oil output to 32.5 mbd, effective January 2017 and for an (extendable) duration of six months. Oil prices have rallied since the start of talks about an OPEC cut. Combined, the recent OPEC deal and the massive decrease in investment since the start of the collapse in oil prices will lead to reduce excess supply next year, although US investment in oil extraction has already rebounded. High inventory levels and a rapid response from US shale producers should limit the scope for a sharp rise in prices in the near future. In addition, the credibility of the OPEC deal might eventually be put into question, considering the history of non-compliance with OPEC quotas.

Question 3. Is the shift in cost structure permanent or temporary?

The short answer is that the shift is temporary. An important fact regarding the slump in prices is the significant downward shift in the cost structure associated with oil production. A commonly held belief is that the cost structure that is often proxied by breakeven prices – the price at which it is economical to produce a barrel of oil – is constant and driven by immutable factors such as the nature of the oil extracted and associated geology (see Figure 2).

Figure 2 Global liquid supply curve (US$/bbl)



Source: Rystad Energy research and analysis.

In practice, the cost structure depends on a host of factors, including technological improvements and the extent of learning by doing. In instances such as the recent dramatic drop in prices, breakeven prices have moved downwards in sync with oil prices. This shift is explained by the operational efficiency gains stemming from the service industry's significant reduction in margins to support the upstream sector. In the specific case of shale oil, its extraordinary resilience to the drop in prices can be explained by important efficiency gains compounded by the fact that shale was at the onset of the investment cycle, where learning by doing is important. Going forward, it is likely that shale cost structure will shift back up somewhat as some of the efficiency gains cannot be sustained and the cost of capital is high.

Question 4. Do futures market (truly) reflect market sentiments?

Futures have not helped predict market 'breakdown'. The change in market expectations about the trajectory of oil prices, as captured by longer-term futures (only), was reflected after the OPEC meeting in late November 2014. The evidence suggests that futures markets appear to 'learn' only gradually. While oil futures curves gradually ratcheted up throughout the 2000 era to a peak, they ratcheted down abruptly at the end of 2014.

The limitations associated with futures are at least two-fold. First, while they are large in absolute size, they are in fact relatively thin after 12-18 months when considering the volume traded relative to the volume actually consumed. Futures are thus not necessarily reflective of volume traded over the counter. Second, as in other commodities, they are subject to the imbalance between longs and shorts. In other words, there is a higher demand for short-term hedging (say, by oil producers) than long-term hedging (say, by manufacturers). The former are typically willing to accept relatively lower prices to hedge price risks since they can't easily pass on the price change to consumer, contrary to oil and gas intensive manufacturers attempting to protect their cost structure even if oil is relatively small relative to their overall cost base.

Question 5. Why haven't low oil prices (yet) delivered a boost to the global economy?

While a drop in oil prices amounts to a transfer from exporters to importers, the expected net plus stems from the higher propensity to save of the former. Also, it is important to distinguish between supply-driven oil price shocks and demand-driven ones, as the former should lead to a net plus to the global economy while the latter are symptomatic of a slowing global economy.

There are several reasons behind the limited effects associated with lower oil prices on the global economy. A higher-than-expected fall in capital expenditure in the oil sector, especially in North America, has been a drag on the economy. Oil exporters have experienced a higher-than-expected reduction in (government) expenditures. This has led to a reduction in energy subsidies, social services, infrastructure investment, and, in turn, imports from advanced and emerging markets. Pressure to draw down on sovereign

wealth fund assets has also risen, with potential consequences for financial markets against a background of concern about market liquidity. In advanced economies, a large share of the reduction in the net oil import bill seems to have been saved by consumers. In emerging markets, limited pass-through from international to domestic prices led to the windfall not being spent, although it did lead to an improvement in government balance sheets. The dollar appreciation has somewhat limited the fall in domestic currency oil prices. Importantly, interest rate policies are constrained by the zero lower bound environment.

Question 6. What can be made of a (two-way) relationship between the energy transition and oil prices?

The 'energy transition' refers to the shift towards lower-carbon or carbon-free energies such as renewables. The expected lower-for-longer oil price environment will likely delay this transition. In addition to this, the transition faces a host of challenges that will likely take decades to overcome. The future of oil will depend on the complex interplay between demography, technology, and public policy affecting both the supply and demand for oil. In thinking about the future of the oil market, one should think more broadly about energy.

On the supply side, oil will increasingly face competition from other sources of energy such as natural gas and renewables. Oil is, for the most part, used for transportation in the form of oil products such as gasoline, diesel, and jet fuel. As energy-using technology continues to evolve in the transportation sector in the form of hybrid and electric cars, the compartmentalisation between the transport and electricity sectors is bound to disappear. That trend will likely further displace oil to the benefit of natural gas first, and then renewables.

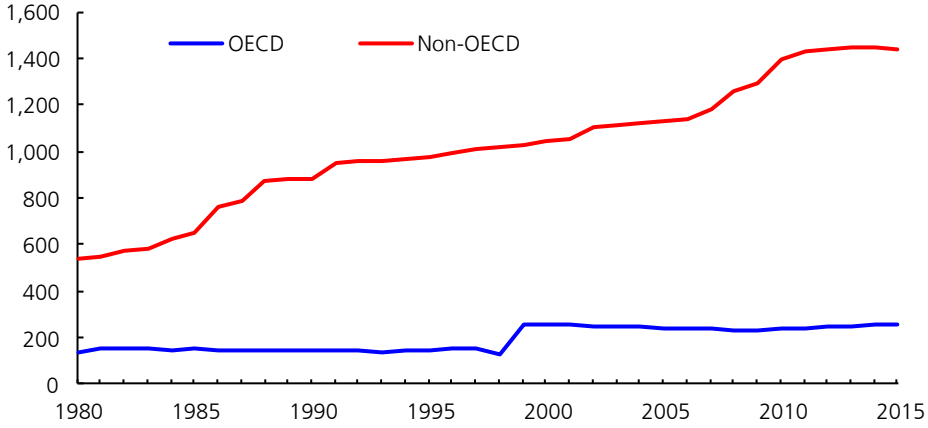
On the demand side, there are countervailing forces. On the one hand, the rapid urbanisation and growing middle classes in emerging markets, especially in Asia, will tend to push up demand for transportation and hence demand for oil. On the other hand, the expected slower growth in emerging markets and public policies geared towards reducing emissions will improve oil efficiency and reduce oil demand.

Question 7. Is it the end of peak oil?

The peak oil hypothesis posited that oil supply will reach a peak in the mid-2000s. That was precisely the same time as the 'shale revolution' started to take off. In many respects, the shale revolution can be viewed as an endogenous supply response to a period of high prices in the 2000s, hence challenging the overly pessimistic view that geological factors were to limit supply. Also, on the energy-producing technology front, the expected 'lower-for-longer' oil price environment could delay the transition. Indeed, there is evidence that firms in the auto industry tend to innovate more in 'clean' (and less in 'dirty') technologies when they face higher fuel prices.

Beyond the response of technology to oil prices, the resource base (what is *known* about geology, as opposed to *true* geology) depends on exploration efforts. Existing evidence suggests that discoveries of oil (as well as other commodities) have occurred mostly in developing countries, including in Latin America and sub-Saharan Africa, that were subject to no material exploration until they became more friendly to such activities (see Figure 3). This increase in discoveries in the South is likely to continue to support supply in spite of depletion in the North and low prices.

Figure 3 Oil proved reserves (thousand million barrels)



Source: BP Statistical Review of World Energy June 2016.

That said, the risks associated with fossil fuel assets becoming stranded are likely to expose many countries to vulnerabilities. The historical COP21 agreement to keep global warming below 2° Celsius and the innovation affecting energy-producing and consuming technologies (the declining cost of producing renewables; hybrid and electric cars) have further boosted the energy transition away from fossil fuels. That means that gigatonnes of reserves will have to stay unexploited underground. To keep the mean global surface temperature increase to below 2° Celsius, only 300 to 400 gigatonnes of carbon can still be burnt, but reserves of private oil and gas majors alone are at least three times as high.

To abide by international commitments to limit global warming, a third of oil reserves, half of gas reserves, and 80% of coal reserves should be kept in the ground forever. This would mean leaving unburned one third of oil reserves in Canada and the Arctic, 50% of gas and 80% of coal (mainly in China, Russia, and the US). In the Middle East, reserves are three times larger than the region's 'carbon budget'. In other words, 260 billion barrels of oil in the Middle East cannot be burnt. In addition to stranded reserves, the structures and capital used in the extraction and exploitation of fossil fuel could become stranded.

One implication of the spectre of stranded assets is that it could lead to a race to burn the last tonne of carbon. That could in turn lead to a 'green paradox' whereby regulation aiming to limit carbon emissions ends up raising emissions, at least in the short run. Some commentators have argued that the collapse in oil prices results from a deliberate attempt on the part of major oil exporters with low marginal cost of production to both crowd out higher marginal cost producers and also to delay the energy transition.

While the risk of stranded assets for fossil fuel exporters appears to be remote, it does pose an existential threat that authorities cannot afford to ignore. Research will further attempt to quantify the phenomena using novel sources of data on natural capital and quantification methods. As mentioned above, it will also explore the extent to which financial markets can inform us about the risk of stranded assets and if not, why.

The energy transition also present opportunities, including for those countries exposed to the risk of stranded assets. According to the US National Aeronautics and Space Administration, solar power concentration is highest in the Middle East and Africa

and parts of Asia and the US. The United Arab Emirates has endorsed an ambitious target to draw 24% of its primary energy consumption from renewable sources by 2021. Interestingly, Morocco – the host of the 2016 United Nations Conference on Climate Change (COP22) – has unveiled the first phase of a massive solar power plant in the Sahara Desert that is expected to have a combined capacity of two gigawatts by 2020, making it the single largest solar power production facility in the world. Research will also rethink the quantification of the natural capital in particular resulting from the advent of renewable resources as a growing source of energy. It will also explore the complementarities between these resources and other forms of capital such as infrastructure, human capital, and soft capital/institutions.

About the author

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Many of Mr. Arezki's research papers have been cited extensively in academic circles and in prominent media outlets such as the *Economist,* the *Financial Times*, the *New York Times*, the *Wall Street Journal*, *Project Syndicate*, and the *Washington Post*. His blog posts including on the recent oil price collapse and its global economic consequences have been viewed over hundred thousand times and have been listed as the most read IMF blog posts three years in a row. Mr. Arezki is also a frequent contributor to *Finance and Development* magazine, VoxEU, an associate editor of the *Revue d'Economie du Développement* and was until recently the Editor of the *IMF Research Bulletin*.

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PART II

Macroeconomic Policy Options

3 How to cope with volatile commodity export prices: Three proposals

Jeffrey Frankel[1]
Harvard Kennedy School

Countries where exports are relatively concentrated in oil, gas, minerals, and agricultural commodities experience terms of trade that are highly volatile. This volatility is one of the possible explanations for the famous 'natural resource curse'.[2]

This chapter offers three policy proposals to help countries manage commodity volatility and thereby help make sure that commodity wealth is a blessing rather than a curse. Two of the ideas fall in the area of microeconomic policy: specific financial contracts structured so as to hedge risk. One of the ideas falls in the area of macroeconomic policy institutions: ways to make fiscal policy counter-cyclical rather than pro-cyclical. (Institutions to make monetary policy counter-cyclical in commodity-exporting countries rather than pro-cyclical are proposed in a companion chapter of this volume.)

It is always hard to make policy proposals that are convincing and at the same time original. I will try to strike a balance between being convincing and being original.

1 This chapter is based on the first half of a keynote address, High Level Seminar, *Natural Resources, Finance and Growth*, sponsored by the Bank of Algeria, Algiers, May 28-29, 2016. The author would like to thank participants at the Bank of Algeria conference; the annual research conference of the Bank of Chile, Santiago, Oct. 23, 2014; a seminar of the OCP Policy Center, Casablanca, Morocco, June 3, 2016; the annual meeting of the Agricultural and Applied Economics Association, Boston, August 1, 2016; and a conference at the Inter-American Development Bank, April 18, 2017.

2 See Brueckner and Carneiro (2016), Blattman, Hwang, and Williamson (2007), Hausmann and Rigobon (2003), Mendoza (1997) and Poelhekke and van der Ploeg (2007). Terms of trade volatility hurts growth in the presence of investment irreversibilities and credit constraints (Aghion et al. 2010). In Frankel (2012), I survey the natural resource curse.

Let us first pause to ask: Don't commodity exporters already use financial markets to smooth trade fluctuations? It is true that if international financial markets worked well, countries facing temporary adverse trade shocks could borrow to finance current account deficits, and vice versa. But they don't work that well. Capital flows to developing countries tend not to be counter-cyclical, as in intertemporal optimisation theory, but rather pro-cyclical (e.g. Kaminsky et al. 2005). The more realistic theory usually builds on the assumption that creditworthiness is imperfect and therefore borrowing requires collateral in the form of commodity export proceeds. For this reason, the supply of funds increases during commodity booms and falls during commodity busts. The important point for policymakers is that some careful thought is required to design institutions that can protect against the volatility.

A variety of policies and institutions for dealing with commodity volatility have been proposed and tried in various countries. Some have been successful, some much less so. Many of the ideas that tend to work poorly can be described as seeking to suppress price volatility rather than manage it. I see them as akin to King Canute commanding the tide not to come in. I am thinking, for example, of price controls, commodity marketing boards, and controls on exports. Better to accept fluctuations in demand and supply as a fact of life, and to devise policies and institutions to equip the economy to cope with them.

Ideas for financial hedging of short-term risk: Options

The general theoretical case for hedging is clear – hedging allows for efficient sharing of risk (e.g. Borensztein et al. 2013).

Of my two suggestions for ways to hedge risk, one having to do with derivatives has been tried and proven successful in protecting against short-term declines in the world price of the export commodity. I have in mind the options market. Mexico annually buys contracts for put options on a large scale to protect itself against a decline in the dollar price of oil (Duclaud and García 2012). This strategy proved especially useful when global commodity prices fell abruptly in 2009 and 2014-15.

Why not use the futures or forward market? Ghana has apparently tried this for cocoa, with some success (IMF and World Bank 2011: 47). But the futures strategy has a major potential drawback, which might be described as an incentive compatibility problem. The minister who sells the commodity forward is likely to get meagre credit if the dollar price of the commodity subsequently goes down, but lots of blame if the price goes up. Better to use options to eliminate the downside risk while keeping the upside potential, although of course one must pay a price for the latter.

A possible limitation in practice for both futures and options contracts is that they are not always readily available for some commodities, particularly at the long-term horizons needed to hedge development of new oil or mineral resources or to hedge the asset value of existing resources. This observation leads to proposal number two.

An idea for financial hedging of long-term risk: Indexing debt to the commodity price

For those countries that borrow (say, a West African country that is developing new deposits of iron ore or offshore oil), I propose indexing the terms of the loan not to dollars or to the local currency, but to the price of the commodity itself (Frankel 2011a). The advantage of such bonds is that in the event of a decline in the world price of the underlying commodity, the debt-to-export ratio need not rise. The cost of debt service adjusts automatically, without the severe disruption that so often results from crisis, debt restructuring, loss of confidence, and so forth. When debt crises hit Indonesia, Russia and Ecuador in 1998, or Ghana, Ecuador, Nigeria, and Venezuela in 2015, one reason was that low dollar prices of their oil exports had driven up their debt service ratios. This would not have happened if their debts had been indexed to the oil price.

The indexation idea has been around for a long time,[3] but has seldom been put into practice. Why not? Potential issuers worry that there is not enough demand for such commodity bonds. "Who would want to take the other side of the trade?", they ask. There is a good answer to the question who the ultimate potential customers are.

3 See, for example, Caballero (2002) and Attah-Mensah (2004); there are earlier precedents.

Airlines and power utility companies have reason to go long in oil, steelmakers have reason to go long in iron ore, chocolate makers to go long in cocoa, and so on.[4]

It must be that bonds denominated in a particular kind of oil and carrying the credit risk of a particular country are too specialised a niche to generate the necessary liquidity to make a viable market. A power company or airline wants to go long in oil, not long in exposure to Azerbaijan, Nigeria or Ecuador, whose credit risk it is not equipped to evaluate. But then the World Bank might be able to make the market. It would lend to interested oil-producing countries – which is its job – in terms of oil in place of lending to them in dollars. It would then offset its collective exposure to oil markets by selling to investors a World Bank bond denominated in a standard oil price index. (Certain major private banks might also be able to play this role of intermediary.) Similarly, countries that export iron ore, cocoa, gold, coffee, and other commodities would borrow from the intermediary in terms linked to the price of the commodity in question and the intermediary would then lay off that commodity risk. The ultimate holder of the commodity exposure would be someone, like a manufacturing corporation, who has a good reason to go long in the commodity in question. All three parties – the borrower, the intermediary, and the ultimate buyer – get exposure to what they want exposure in and protection against what they don't.

Institutions to overcome pro-cyclical fiscal policy in commodity-exporting countries.

The third proposal is in the area of fiscal policy. Government spending has historically been notoriously pro-cyclical in commodity-exporting countries. Governments have tended to increase spending during the boom and have then been forced to cut back when commodity prices go back down. Many authors have documented this historical

4 Logically, commodity bonds should be an 'easier sell' than GDP-linked bonds, which have received more attention (e.g. Borensztein and Mauro, 2004). The first reason is that they have natural customers, as noted. The second reason is that the commodity price index is not subsequently revised and is less liable to government manipulation than are GDP or inflation statistics.

pro-cyclicality.[5] An important cause of pro-cyclical spending is that government receipts from taxes or royalties rise in booms, and the government cannot resist the temptation or political pressure to increase spending proportionately, or more than proportionately, as if the boom will last forever. Two large budget items that account for much of the increased spending from oil booms are big construction projects (Gelb 1986) and the government wage bill (Medas and Zakharova 2009).

It is not enough to observe that policymakers should follow wiser policies. What is wanted are institutions that make it more likely that future fiscal policy will be counter-cyclical, or at least less pro-cyclical, even when carried out by officials who suffer from the common political and human frailties.

Some commodity-exporting developing countries managed after 2000 to overcome their historical pattern of pro-cyclicality. They achieved fiscal counter-cyclicality, taking advantage of the 2002-08 expansion to strengthen their budget balances, which then gave them the 'fiscal space' to ease up when the global recession hit in 2009. Which countries managed this achievement? Generally, those with 'good institutions' judged by the standard measures such as the rule of law (Céspedes and Velasco 2014, and Frankel et al. 2013).

What institutional innovations, more specifically, can a country adopt to fight fiscal pro-cyclicality? The conventional answer is budget rules, for example legally entrenched ceilings on budget deficits. But such rules alone won't do the job, as the failures of Europe's Stability and Growth Pact have amply demonstrated. To begin with, fixed ceilings on budget deficits operate pro-cyclically – when the economy is hit by a recession and so the budget is hit by a loss in tax revenue, a budget balance rule will force the government to cut spending or raise tax rates which will worsen the recession. Phrasing the target in cyclically adjusted terms helps solve that problem in theory. But most such rules are violated in practice, even more so for developing countries than for

5 Cuddington (1989), Gavin and Perotti (1997), Tornell and Lane (1999), Kaminsky et al. (2004), Talvi and Végh (2005), **Alesina** et al. (2008), Mendoza and Oviedo (2006), Ilzetski and Vegh (2008), Medas and Zakharova (2009), Arezki et al. (2011), Arezki and Brückner (2012a, 2012b), Erbil (2011), and Avellan and Vuletin (2015).

advanced countries. One major reason is overly optimistic forecasts by official agencies (Frankel 2011, Frankel and Schreger 2013).

In a study of Chile's successful fiscal institutions (Frankel 2013),[6] I concluded that the key feature was not by itself the adoption of cyclically adjusted budget balance. Others have tried this and failed. It was, rather, the delegation to independent committees of the responsibility to estimate the long-run trends in the copper price and GDP. This delegation avoided the systematic over-optimism that plagues official forecasts in most other countries. It could be a useful model for others to emulate.

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4 Monetary regimes to cope with volatile commodity export prices: Two proposals

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The US Federal Reserve and some of the other more important central banks may have given up, at least for the time being, their attempts to communicate monetary policy intentions in terms of a single variable even via forward guidance, let alone via an explicit target. The presumption, however, is still in favour of transparency and simple clear communication. Many still feel the need to announce a specific target or anchor. Most developing countries, in particular, need the reinforcement to credibility (Fraga et al. 2003). Monetary policymakers in emerging market and developing countries often have more need for credibility than those in advanced countries due to high-inflation histories, an absence of credible institutions, or political pressure to monetise big budget deficits. But announcing a target that one can often expect to miss does little to enhance credibility.

Commodity-exporting countries have bigger terms-of-trade shocks than industrialised countries. As has long been understood, terms of trade volatility makes a country less suited to a fixed exchange rate and more suited towards some form of floating so that the exchange rate can accommodate terms of trade shocks.

One good criterion for judging whether monetary policy in a commodity-exporting country is counter-cyclical is whether the currency is allowed to appreciate in the face of a *positive* terms-of-trade shock and to depreciate in the face of a *negative* terms-of-

1 This chapter is based on the second half of a keynote address, High Level Seminar, *Natural Resources, Finance and Growth*, sponsored by the Bank of Algeria, Algiers, May 28-29, 2016.

trade shock. By this criterion, a fixed exchange rate is acyclical, by definition. By other criteria, a currency peg can actually be *pro-cyclical* – commodity booms are associated with money inflows, rapid credit expansion, an overheated real economy, inflation in non-traded goods and services, and bubbles in real estate and other assets. Conversely, commodity busts are associated with balance of payments deficits, loss of reserves, credit shortage, recession, and currency or financial crises.

Floating

Flexible exchange rates allow accommodation of trade shocks, and therefore a counter-cyclical monetary policy. Under free floating, when the global price of the export commodity rises, threatening overheating, the currency automatically appreciates to mitigate the problem. When the global price of the export commodity falls, threatening external balance difficulties and recession, the currency automatically depreciates to mitigate those problems.

Examples of 'commodity currency' countries include Australia, Canada, Chile, New Zealand and South Africa (Cashin et al. 2004, Chen and Rogoff 2003, Frankel 2007). Empirically, floating delivers a high correlation between the exogenous price of the export commodity and the real effective exchange rate, thus accommodating terms-of-trade shocks, while fixing does not. A variety of empirical studies confirm that floating works better for countries exposed to volatility in the world prices of their export commodities (Broda 2004, Edwards and Levy-Yeyati 2005, Rafiq 2011, Céspedes and Velasco 2012, Berg et al. 2016). Céspedes and Velasco (2012), for example, look across 107 major-country commodity boom-bust cycles and find that the more flexible the exchange rate, the smaller the output loss from a given price decline.

Of course, the advantages of fixing are still likely to dominate for very small, very open economies (or for low-income countries that lack developed financial markets). Examples among oil exporters include Bahrain, Brunei, Cameroon, and Trinidad.

Price index targeting

For middle-sized, middle-income commodity-exporting countries, if the exchange rate is not to be the anchor, what is? The popular choice since the 1990s has been inflation targeting (IT), meaning the announcement of a target for the CPI in some form. IT comes in variations – choices include targeting the level of the CPI versus the rate of change, headline CPI versus core, and forecasted inflation versus actual.

One point is not widely enough considered: regardless which variation, the CPI is a bad choice for targeted variable with respect to terms-of-trade shocks. Assume a country that exports oil and imports food. If interpreted literally, a CPI target prevents the central bank from responding to a fall in the dollar price of oil with easy enough money to depreciate the currency (otherwise the domestic price of food will rise, violating the CPI target); and it requires the central bank to respond to a *rise* in the dollar price of imported food by tightening enough to *appreciate* the currency (for the same reason). This is backwards; it exacerbates terms-of-trade shocks rather than accommodating them. A short-term CPI target produces pro-cyclical, rather than counter-cyclical, monetary policy. It is like the currency peg in this regard, but more so.

If the authorities are going to target inflation, the price index should be one that leaves the import commodity out of the basket, but includes the price of the export commodity – something output-based, rather than designed to reflect the consumption basket. If the Bank of Algeria were to target the GDP deflator, for example, it would automatically respond to declines in the world price of oil with monetary policy easy enough to depreciate the dinar, which is what one wants, and not when the price of the *import* commodity falls which is what a CPI target does (Frankel 2011, 2012). Unfortunately, nobody has tried out the proposal to target the GDP deflator.

The currency-plus-commodity basket proposal

An alternative, especially for countries like Kuwait that currently target a basket of major currencies such as the dollar and euro, is to add the export commodity to the basket. I call this proposal a currency-plus-commodity basket (CCB). If the Kuwaiti dinar were pegged to a basket that gave one-third weight to the dollar, one-third to the

euro, and one third to oil, the value of the currency would again automatically move up and down with the value of a barrel of oil. Among Gulf countries, swings in external balance and in internal balance during 2001-16 are attributable to the inability of their exchange rates to adjust to the ups and downs in oil prices in a way that the proposal for a CCB would deliver automatically (Frankel 2008). The argument in favour of a CCB is that, for a commodity-exporting developing country, it delivers the best of floating (automatic accommodation of trade shocks) together with the best of fixed rates (a stable and transparent anchor).

Historical analysis (Frankel 2018)[2] of Saudi Arabia, Kuwait, and smaller Gulf countries during the period 2001-16 identifies sub-periods when the existing exchange rate arrangements led to a currency that we label 'undervalued' relative to the higher level it would have attained if the currency-plus-commodity basket proposal had been in place. The other sub-periods we label as having been 'overvalued' by this criterion.

The finding is that during the undervaluation sub-periods, the inflation rate tends to be high, a symptom of excess demand or overheating. During the overvaluation sub-periods, the inflation rate tends to be low, a symptom of excess supply or recession. Similarly, during the undervaluation sub-periods, accumulation of foreign exchange reserves tends to be high, while during the overvaluation sub-periods, reserve accumulation tends to be low. These findings support an important claim: if Gulf countries had followed the currency-plus-commodity basket proposal during the period 2001-16, their economies would have moved in the direction of external balance (a more stable balance of payments) and internal balance (greater stability in growth and inflation).

The research offers a practical blueprint for detailed implementation of the currency-plus-commodity basket proposal by any country's monetary authorities that might be interested in considering it. Four decisions would have to be made regarding the specific design details of the arrangement:

2 Summarised in Economic Research Forum Policy Brief No. 26, June 2017, Cairo.

1. *Choice of major currencies to go into the formula*
   For the Gulf countries, we assume it would be just the dollar and euro. But some countries might want to consider adding the currencies of other important trading partners, for example, the Russian ruble and Chinese yuan in the case of Kazakhstan.

2. *Oil price index to be used*
   The daily settlement price for Brent crude oil set at, say, 19:30 London time on the InterContinental Exchange could be used as an objective and exogenous measure of the oil price. Another index could be chosen instead, so long as it is transparent.

3. *Computation of the coefficients on the major currencies and oil*
   After identifying the major currencies and oil price index that are to enter the basket, the next step for the central bank is to compute and announce regularly (for example, once a year) the numerical weights that are to be assigned to each of these basket components.

4. *Frequency with which the coefficients would be revised*
   A country operating a currency-plus-commodity basket regime might find in the future that it wishes to raise or lower the importance assigned to major trading partner currencies or to the oil objective. Governments that announce that their currencies will follow basket pegs often wish to preserve more flexibility than a permanent iron-clad commitment to the new regime would imply. The best way to do this is not to keep the formula secret, but rather to announce publicly and transparently the initial parameters as well as whatever subsequent changes are thought necessary.

Nominal GDP targeting

A more familiar-sounding recommendation is to target nominal GDP (NGDP) (Frankel 2014, Bhandari and Frankel 2017).[3] It has the same advantages as targeting the nominal

3 Summarised in "Nominal GDP Targeting for Developing Countries", VoxEU.org, August 2014.

GDP deflator (accommodating shocks to the terms of trade better than a CPI target) and has other advantages as well: it also beats CPI-targeting in case of supply shocks.

Many prominent economists have proposed or studied NGDP targeting. The other supporters have almost always been thinking of major central banks like the Federal Reserve or the Bank of England. In the 1980s, NGDP targeting was proposed by Meade (1978) and Tobin (1980) and supported by many others. The point of announcing an explicit target at that time was to get expectations of inflation down. In recent years the proposal has been revived (e.g. by Woodford 2012, plus a school that calls itself Market Monetarists). The point in recent years (in advanced countries) has been to get expectations of inflation *up*. Either way, the argument in favour of phrasing the monetary stance in terms of NGDP is that this formulation is robust with respect to supply shocks

One can show that if the ultimate objective is to achieve price stability and output stability, as represented by a quadratic loss function, then a NGDP target will give a better outcome in the presence of shocks than an inflation target unless the supply curve is very steep or the loss function puts extraordinarily high weight on stabilising the CPI.

Under certain simplifying assumptions, the necessary condition for nominal GDP targeting to dominate inflation targeting is:

$$a < (2 + b)b$$

where $a \equiv$ the weight on the price stability objective in the loss function, and $b \equiv$ elasticity of output with respect to unexpected inflation (i.e. inverse slope of the aggregate supply curve).

The difference in welfare is especially large if supply shocks are especially large. There is good reason to think that supply shocks, like terms-of-trade shocks, are larger for commodity producers and other developing countries, due to more strikes and social instability, greater vulnerability to severe weather events such as droughts and

windstorms and other natural disasters such as earthquakes, and bigger productivity shocks.[4]

Does the inequality condition hold? It does if the aggregate supply relationship is flat, as compared to the slope of the loss function lines. To simplify even further, consider two examples.

- Example 1: The condition holds if $b > a$.
- Example 2: It also holds if $a = 1$ (as in the original Taylor rule) and the aggregate supply slope $1/b < (1 + \sqrt{2}) = 2.414$.

So NGDP targeting dominates unless aggregate supply is very steep (relative to the weight on price stability). I have estimated the aggregate supply slope for a few middle-size, middle-income countries where I could think of plausible instruments for aggregate supply shocks and aggregate demand shocks. A good one is Kazakhstan, over the period 1993-2012. (The exogenous supply shocks are oil price fluctuations. Exogenous demand shocks are changes in income of major trading partners and military spending.) The estimated aggregate supply slope is 1.66; it is statistically less than 2.41. The implication is that the condition required for NGDPT to dominate IT apparently holds.

Conclusions

I conclude that middle-size, middle-income commodity-exporting countries that currently favour targeting the CPI should consider using nominal GDP as their target instead. Commodity-exporting countries that currently peg their exchange rates to one or more major currencies should consider adding the export commodity to the basket to which they peg. In both cases, the aim is to accommodate the trade shocks to which commodity exporters are so often vulnerable, while at the same time providing stable and transparent monetary policy.

4 During a boom, the country does not know in real time whether rapid productivity growth is permanent (it is the next Asian Tiger) or temporary (the result of a transitory fluctuation) (Aguiar and Gopinath 2007). Because exogenous productivity shocks are hard to measure, extreme weather events and commodity price fluctuations are more useful as instrumental variables.

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5 Managing oil and gas revenue before and after the crash

Rick van der Ploeg
University of Oxford and CEPR

Introduction

Countries with substantial oil and gas revenues often have bad records in economic growth, especially if institutions are poor, rule of law is inadequate, financial markets are poorly developed, and there are many trade barriers. Sharp appreciations of the real exchange rate hurt non-oil/gas export industries so that production factors are reallocated from the tradables to the non-traded sectors. Private consumption and public spending thus suffer from excessive volatility, which damages welfare. Many such countries are still developing and are unable to harness the once-in-a-lifetime opportunity of a temporary windfall to boost the process of economic development. It is therefore important to ask how fiscal and monetary policy can contribute to a better use of oil and gas windfalls.

Such policies have to deal with periods of unemployment, big swings in the real exchange rate and the allocation of production factors, and preparing the economy to efficiently absorb the extra consumer and investment demands resulting from the new wealth associated with the windfall. Since government debt is not neutral, the timing of handing back dividends matters. In this chapter, I argue that absorption constraints require appreciation of the real exchange rate to boost investment in home-grown structures (infrastructure, health, education, etc.) so that, with time, a more efficient spending of the windfall can take place. And the timing of handing out revenue from the windfall matters as even a permanent-income rule leads to volatility of fund withdrawals and to overshooting of the real exchange rate and real consumption (as households run down assets and the current account eventually turns into surplus). I also comment on

the short-run role for monetary and exchange rate policy in dealing with a crash in commodity prices if nominal wage rigidity prevails, and compare a nominal exchange rate peg with a Taylor rule that targets inflation, unemployment, and the real exchange rate.

Revisiting the classical policy prescription: Dutch disease effects

Let us consider structural change in an oil- or gas-rich small open economy with a traded sector and a non-traded sector. I assume perfect competition on all factor and goods markets, full employment of all factors of production, and free movement of these factors between the two sectors in each period. Suppose that the government has access to international capital markets, but liquidity-constrained households do not. Also suppose that each sector has a production function that displays constant returns to scale and all variable factors of production can be instantaneously adjusted. I assume that tradables are intensive in labour. Demand for non-tradables must equal the supply of non-tradables in each year. The excess of production and commodity income over consumer spending is saved. We then get the following comparative statics results: a windfall boosts real consumption and leads to an appreciation of the real exchange rate in as far as the oil and gas windfall is not saved. The real appreciation is especially large if demand and supply of non-tradables do not respond much to changes in prices. Equilibrium after the windfall is restored by a contraction of the tradables sector and an expansion of the non-tradables sector, which results from factors moving from the tradables to the non-tradables sector. Still, consumption of tradables increases and is met by additional imports from abroad. The future has additional income (principal plus interest) from saving foreign assets and has similar comparative statics results.

Given that policymakers maximise utilitarian welfare (the sum of lifetime utilities), one gets the following policy implications. Growth of real consumption is high if the return on financial assets is high, impatience is low, and the current price of non-tradables is high relative to the future price. Full intertemporal smoothing of the real exchange rate, and thus of real consumption, is called for. Thanks to access to international capital markets, a boost to present or future windfall revenue boosts present and future consumption by equal amounts. This avoids volatile reallocations of labour and other

production factors from the traded to the non-traded sector. The windfall leads instead to a small permanent contraction of the traded and expansion of the non-traded sector.

Fighting unemployment during an oil price crash

An oil price crash induces depreciation of the real exchange rate and, if the real consumption wage is rigid in the short run, can cause unemployment. Let the short run be characterised by real wage rigidity and the long run by full employment. Let the real consumption wage in this initial sub-period be fixed at its pre-crash value. The real wage facing non-tradables producers falls and that facing tradables producers rises with the price of non-tradables, so employment falls in the traded sector but rises in the non-traded sector. A drop in consumption is associated with real depreciation and a drop in employment. To curb the blow to unemployment, one must cut consumption by less to limit the depreciation of the real exchange rate.

Absorption constraints: The need to invest in home-grown structures

Many developing economies are confronted with bottlenecks in the productive capacity of the domestic economy. They find it tough to quickly and efficiently absorb the spending hike induced by a windfall, and need the right amount of domestic infrastructure and capital (called 'structures') in place before the windfall can be spent. The classical policy prescriptions, then, are no longer valid. To show this, I allow for absorption constraints and structures. I thus let production in each sector depend on home-grown structures. These consist of infrastructure, human capital, health, the quality of the civil service and the judiciary, and so on, and must be produced by the non-traded sector. I assume that the non-traded sector is intensive in structures and the traded sector is intensive in labour. If structures are produced entirely by the non-traded sector, the efficiency condition requires that the user cost consist of the usual rental and deprecation charges minus the capital gains that result if firms anticipate that prices of non-tradables will rise in the future. Gross national product (GNP) may also depend on capital stock imported from abroad. With perfect capital markets, the windfall revenue can be fully amortised. The windfall thus implies a drop in the social value of wealth

and a permanent increase in consumer spending. We can trace the effects of a windfall-induced drop in the marginal value of wealth on structures and the real exchange rate from the condition for equilibrium in the market for non-tradables and the efficiency condition for structures.

A windfall-induced permanent increase in consumption leads to an immediate jump upwards of the relative price of non-tradables. This signals the need for expansion of the non-traded sector and contraction of the traded sector, which is made possible by a relocation of labour from tradables to non-tradables production. However, the additional spending on non-tradables is only fully made possible once the economy has accumulated enough structures to boost the productive capacity of non-tradables. Over time, investment in structures takes place and the relative price of non-tradables falls. Once absorption constraints are fully alleviated, the price of non-tradables has returned to its original equilibrium. In response to the windfall, we thus see that real consumption undershoots its new higher long-run value.

Since structures cannot be acquired on world markets, they must be home-grown. Since this takes time, structures slow down growth and development. This dynamic adjustment process captures the absorption constraints that hinder a quick harnessing of natural resource windfalls facing many developing countries. The mechanism behind these absorption constraints relies on the production of non-tradables being more intensive in structures than the production of tradables. If this is not the case, the real exchange rate does not respond to a windfall at all, and instead capital is slowly run down by wear and tear to allow gradual release of labour and other factors of production from the traded sector, allowing the non-traded sector to expand. This process seems less relevant for developing countries.

Debt matters when managing windfalls

With operational intergenerational bequest motives, it does not matter whether the government hands out the windfall directly or hands it out via a permanent-income rule. Here I depart from Ricardian debt neutrality so that the *timing* of natural resource handouts to private agents does matter. An increase in government consumption thus does not lead to 100% crowding out of private consumption. This allows us to

meaningfully discuss and compare the effects of permanent-income and spend-all rules for managing natural resource windfalls on the time paths of consumption, the current account, the real exchange rate, and asset holdings.

Net foreign asset holdings are the sum of private and fund asset holdings minus government debt. The sovereign wealth fund contains above-ground financial wealth from accumulated saving of windfall revenue. Below-ground oil and gas wealth is the present value of resource revenue. Permanent oil and gas income is the return on this wealth. The permanent-income rule states that the amount taken from the fund for general budget purposes must equal permanent resource income plus interest income on fund wealth. This transfer is constant, so total above- and below-ground wealth is constant under the permanent-income rule too. Any running down of below-ground oil and gas wealth must therefore be exactly mirrored by accumulation of above-ground wealth in the fund.

To focus on the operation of sovereign wealth fund, I abstract here from government debt and spending and suppose that society's pure rate of time preference exceeds the world return on financial assets. I can thus show that the real exchange rate appreciates and real consumption jumps up immediately with no effect on household asset accumulation upon news of a temporary windfall. However, given that households are impatient, real consumption and the exchange rate overshoot their steady states. Over time households run down assets, but the country eventually accumulates foreign assets, consumption falls, and the real exchange rate depreciates, and the initial contraction of the non-traded sector and expansion of the traded sector are partially reversed. If the entire windfall is spent as it comes in, consumption jumps up by a bigger amount and households accumulate assets during the windfall and decumulate them again afterwards, so the country has current account surpluses during the windfall and deficits afterwards. The permanent-income rule allows a permanent smaller boost to consumption, while the spend-all rule allows a temporary bigger boost to consumption.

Policy simulations indicate that that households temporarily save and accumulate if government hands out the windfall immediately to them, but borrow permanently if the government employs a permanent-income rule. Private agents thus engage in saving if the government fails to fully smooth withdrawals from the fund. Under the bird-in-hand rule (taking a constant fraction each year out of the fund), private agents borrow

even more to offset the very prudent saving policy implemented by the government. But over time households start saving again under this rule as fund assets, and thus the government, withdrawal start declining. Interestingly, under all three policy rules there is a sharp temporary appreciation of the real exchange rate which signals the need to invest in structures to expand the sector producing non-tradables.

The stock of structures rises most under the spend-all rule, because under that rule the real exchange rate appreciates most as under finite lives, private agents cannot fully offset the lack of saving by the government under this rule. The rise is permanent under the permanent-income rule. As a result, production of non-tradables and GNP rise in the short run and then return to pre-windfall levels under the spend-all rule (as they do under the and bird-in-hand rule), but stay permanently higher with the permanent-income rule. The pattern is repeated for real consumption – the increases are concentrated up front for the spend-all rule and for a prolonged time in the medium run for the bird-in-hand rule, but effects vanish in the long run for these two rules. The permanent-income rule manages to smooth the time path of consumption most, although consumption rises a little more in the short than in the long run. The permanent-income rule also manages to avoid volatility in the allocation of labour to the two sectors more than the other two rules. As private liabilities rise in the long run under the permanent-income rule, net foreign assets end up lower.

Short-run policy responses to a crash in commodity prices

Most oil and gas windfalls last for decades or even centuries, so it is natural to focus on the medium and long run. However, news about a pending windfall or a crash in the oil price can also have large short-run effects on macroeconomic outcomes if labour markets respond sluggishly. Here, I briefly discuss the short-run effects and potential policy responses under both real and nominal wage rigidity.

Let us focus first on real wage rigidity. Aggregate employment then decreases in the rate of appreciation of the real exchange rate, or equivalently increases in the marginal product of structures. Given that we suppose that non-tradables are intensive in structures, employment increases in the price of non-tradables. Hence, an oil or gas discovery that causes on impact a temporary appreciation of the real exchange rate and

a boost to the real consumption wage leads to temporary shortages of labour. Over time, as the real exchange appreciation is reversed and the real consumption wage falls back, employment falls back to its full-employment level.

Conversely, a temporary crash in the oil price gives on impact a sharp depreciation of the real exchange rate, which erodes the real consumption wage and causes unemployment. As the real exchange rate and the real consumption wage recover, employment recovers until all unemployment is eliminated. Real wage rigidity leads to higher transient unemployment under a spend-all rule than under the bird-in-hand rule, and even more so than under the permanent-income rule, because the former rule is associated with sharper temporary depreciations of the real exchange rate.

Real wage rigidity may be pervasive in labour markets, but nominal wage rigidity is important too, especially in the short run. The 1980s-style models of real exchange rate overshooting feature nominal wage rigidity in combination with forward-looking exchange markets. They have been used to analyse the adverse effect on competitiveness and Dutch disease and the appropriate monetary response. They have also been used to show that, following news of an oil discovery, markets anticipate a future windfall-induced boost to spending which leads, before the revenue has started pouring in, to an appreciation of the real exchange rate, a drop in net non-resource exports, and temporary unemployment. The recent strand of new Keynesian micro-founded macro models has been used to show that the wealth effects of an anticipated oil or gas bonanza imply that the forward-looking component of inflation suppresses output below its natural level, leading to a recession; if the central bank follows a simple Taylor rule that tightens aggressively against inflation, it will exacerbate this recession.

A crash in the oil price implies that investors in the mining and exploration sectors scale back investment and production activity. Furthermore, households anticipate a drop in future income and thus cut spending, firms in non-tradable sectors hold off investment in structures, and there the government needs to cut spending. With nominal wage rigidity, these negative demand shocks cause temporary falls in output and unemployment. Offsetting these shocks requires the price of non-tradables to fall relative to tradables, which takes time with sticky prices and so unemployment is inevitable. Looser monetary policy avoids contraction of tradables sectors such as manufacturing by bringing spending forward and allowing the nominal exchange rate

to depreciate, but many oil/gas-exporting countries face constraints on monetary policy (due, for example, to badly functioning financial markets or a peg) so the fall in demand cannot be perfectly offset.

With real wage sluggishness, a Taylor rule can improve on a nominal exchange rate peg by loosening monetary policy following a crash in the oil price, especially if the fiscal authorities implement a 'tighten your belt' rule instead of a permanent-income rule. Given that a peg severely constrains monetary policy's ability to respond to demand shocks, including global shocks to the oil price, it is puzzling that three quarters of oil/gas-rich countries have a nominal exchange rate peg.

With imperfect substitution between home and foreign assets, disaggregation of the sovereign wealth fund, the treasury, and the central bank is needed. Central banks trying to prevent worsening competitiveness and an appreciating currency in the wake of a windfall then sell their own currency and buy up foreign reserves, which can lead to substantial accumulation of foreign reserves at the central bank – akin to a de-facto sovereign wealth fund. Central banks faced with a crash in the oil price and a government that does not use fiscal policy to smooth consumption and the real exchange rate might step in to prevent the currency from depreciating and inflation rising too fast. As we have witnessed in recent years, however, this policy will lead to a rapid depletion of foreign reserves.

Concluding remarks

Macro management of commodity price shocks in resource-rich developing countries needs to take account of the following:

- First, short-run unemployment caused by a commodity price crash when the real wage is rigid also necessitates bringing consumption forward to mitigate unemployment.
- Second, developing countries need structures to boost production of non-tradables. As structures are mostly produced at home, these countries must invest to more efficiently absorb the extra consumption and investment spending associated with a windfall. Even a permanent-income rule requires a sharp temporary appreciation

of the real exchange rate to signal gradual expansion of non-tradables production by investing in structures. Over time, more and more labour and other production factors are drawn out of tradables into non-tradables production. As this happens, the price of non-tradables falls back to its original level.

- Third, debt matters, especially in developing countries, so the timing of oil and gas dividends also matters. A permanent-income rule leads on impact to a sharp appreciation of the price of non-tradables and upward jump in real consumption, overshooting their higher steady-state values. As households decumulate assets and consumption falls, the price of non-tradables falls and current account deficits switch into surpluses. Over time, the depreciation of the real exchange rate partially reverses the contraction of non-tradables production and expansion of tradables production. If the temporary windfall is immediately handed to citizens, consumption jumps up by a bigger amount and households accumulate assets during the windfall and run them down afterwards, as the government does not engage in saving on their behalf.
- Finally, the short-run impact of oil and gas windfalls and an oil price crash can be considerable. If real wages respond sluggishly to unemployment and non-tradables production is intensive in structures, a crash in the oil price causes temporary unemployment, more so under the spend-all rule than under the permanent-income or bird-in-hand rule due to the sharper depreciation of the real exchange rate associated with not saving the windfall. If nominal wages are sluggish in the short run, a monetary policy response is required to mitigate unemployment and inflation, and a Taylor rule performs better than a nominal exchange rate peg. If the central bank steps in during a crash in commodity prices to prevent rapid nominal depreciation of the currency and inflation, foreign reserves will be rapidly depleted and may lead to a speculative attack on the currency. Governments in developing economies may find it tough to cut spending or raise non-resource taxes to make up for the drop in resource revenue, even though this is needed if the crash is expected to last a long time. Fund wealth is then rapidly depleted and government debt escalates until the market is no longer willing to buy more debt. The subsequent switch to monetary finance boosts inflation, and if this switch to money finance is anticipated, higher inflation can already occur before this switch.

This myriad of short-run macro misery highlights the importance of sound medium- and long-run management of resource wealth to cope with the inevitable volatility in both resource production and commodity prices.

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Rick van der Ploeg is Professor of Economics at the University of Oxford, having previously been an academic at the University of Cambridge (1977-1983), London School of Economics (1983-1988), Tilburg University (1985-1991) and the European University Institute, Florence (1988, 2003-7), a Chief Financial Spokesperson in the Dutch Parliament (1994-98), a State Secretary for Education, Culture and Science (1998-2002) and an elected member of the UNESCO World Heritage Committee (2003-7). He is also affiliated with CEPR, CESifo, Oxcarre, Netspar, VU University of Amsterdam, and the Tinbergen Institute.

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6 Oil prices and the exchange rate: Optimal monetary policy for oil-exporting countries

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Introduction

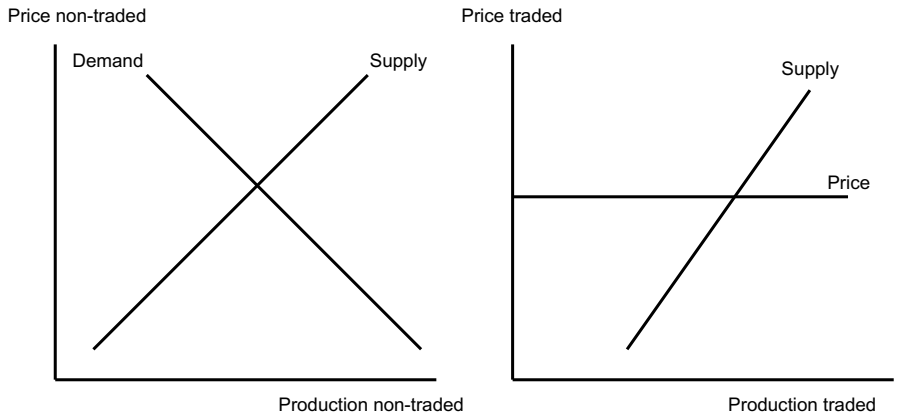
In 2014, the oil price went from US$115 per barrel to below $30 per barrel in less than half a year. This oil price shock illustrates both the uncertainty and the volatility of oil prices. Such shocks present oil exporters with many policy challenges. In this chapter, I study those challenges that relate to how monetary policy should respond to oil price shocks. If an oil price shock is temporary, then the question is how monetary policy should smooth out the fluctuations caused by the shock until times are 'normal' again. If there is some persistence in the shock, however, then additional challenges present themselves. First, there is a need for a structural adjustment to make the economy less reliant on oil income, for example by diversifying into other industries that can act as alternative sources of foreign exchange earnings (or saving foreign exchange by replacing imports). Second, the use of fiscal policy to smooth the shock may, in such a case, be problematic since the fiscal position is weakened over time, actually calling for a less expansionary fiscal policy.

1 This chapter is based on a presentation held at the Bank of Algeria seminar in 2016, and also draws from analysis done by the author for the Ministry of Finance in Norway to discuss policy responses after the oil price shock from 2014 (and onwards).

Macroeconomic policy in a two-sector model

Consider a small open economy, which faces given international prices of (traditional) traded goods and of oil, and where oil exports are a substantial source of income. Nominal wages are not allowed to adjust so as to achieve full employment in the short run. Figure 1 shows this economy before it is hit by the oil price shock. The left panel represents the non-traded sector, while the right panel represents the traded sector. In the left panel, the demand for non-traded goods is decreasing in their prices, since a higher price shifts demand towards traded goods and away from non-traded goods. The supply is increasing in the price. Since non-traded goods cannot be exported or imported, equilibrium in the market for non-traded goods requires domestic demand to equal domestic supply, which establishes the equilibrium at the intersection of the demand and the supply curve in the left panel of Figure 1.

Figure 1 The model

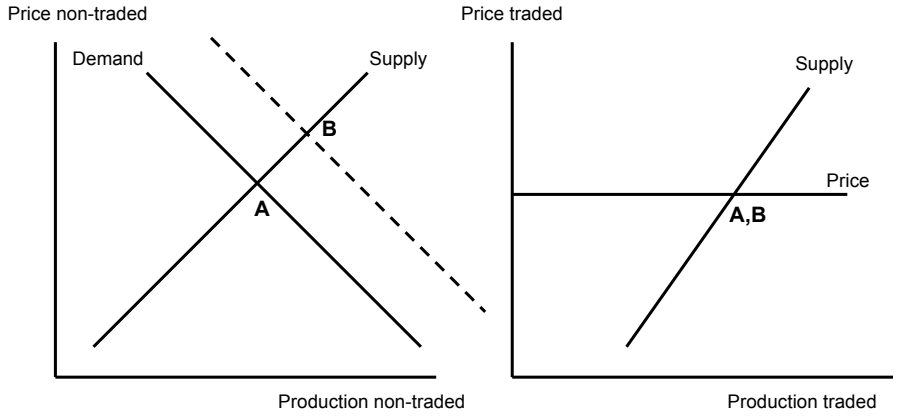


Production in the traditional traded sector, on the other hand, is determined independently of domestic demand for traded goods, as shown in the right panel of Figure 1. Supply is increasing in the price of traded goods, but the price is given at the world market, as illustrated by the horizontal price line. Output is determined at the intersection of the supply curve and the price curve in the right panel of Figure 1.

Fiscal policy

The effect of an expansionary fiscal policy is shown in Figure 2. The initial equilibrium is at point A, but with expansionary fiscal policy the demand curve for non-traded goods in the left panel of the figure shifts to the right. This demand curve after the shift is represented by the dotted curve. In the non-traded sector, the new equilibrium at point B implies that the activity level and the price both increase. In the traded sector, neither the supply curve nor the price curve is affected, and thus the activity level, as well as the price, stay unchanged (i.e. point A before the fiscal expansion, and point B after the fiscal expansion, are the same). The policy increases aggregate output, and deceases unemployment, through the expansion in the non-traded sector.

Figure 2 Fiscal policy



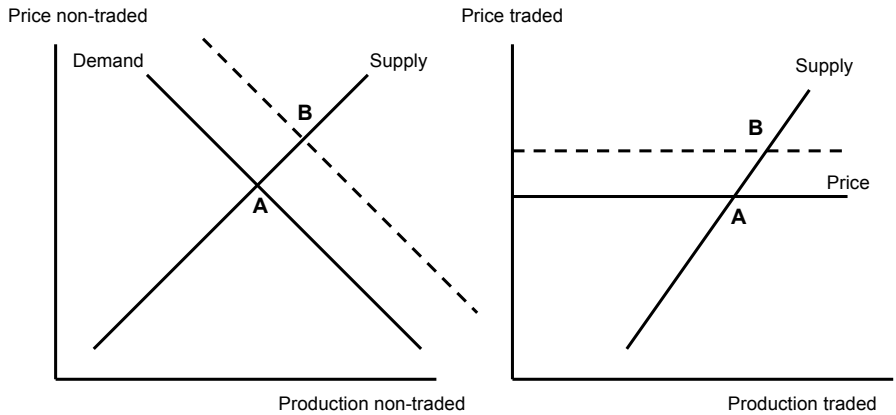
It may be, however, that the wage responds to this new equilibrium. Workers face both higher prices and lower unemployment, both of which may generate a higher nominal wage level. In that case, an expansionary fiscal policy actually has a contractionary effect on the traded sector.

Monetary policy

The effects of an expansionary monetary policy – i.e. lowering the interest rate – are shown in Figure 3. The lower interest rate depreciates the exchange rate, shifting the price curve in the right panel of Figure 3 up to the dotted curve, and increasing

production in the traded sector from point A to point B. The lower interest rate, the higher price of traded goods, and the higher income generated in the traded sector all pull in the direction of increased demand for non-traded goods, shifting the demand curve in the left panel of Figure 3 to the dotted curve, increasing production and prices from point A to point B.

Figure 3 Expansionary monetary policy



Comparing fiscal and monetary policy, an expansionary fiscal policy is likely to have a contractionary effect on the traded sector, while an expansionary monetary policy increases the level of activity in the traded sector.

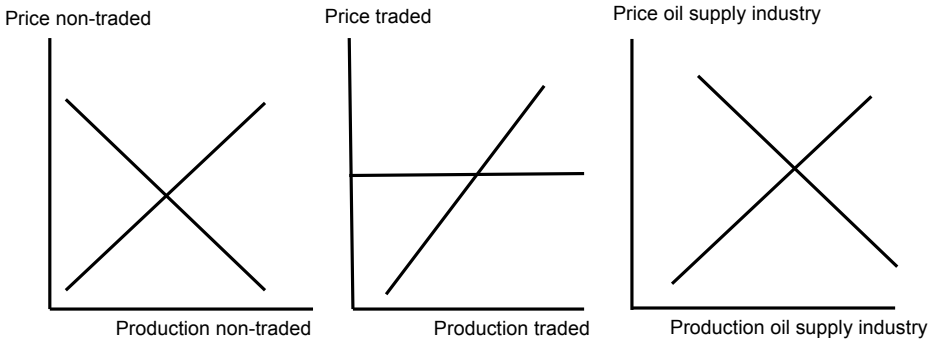
A three-sector model for an oil-exporting country

In two-sector models, an implicit assumption is that the effect of the oil sector is to contribute with income, but without affecting the factor inputs available for the rest of the economy. In most oil-exporting countries, however, a main effect of the oil sector is its backward linkages through demanding inputs from the domestic economy. This implies that a view of the traded sector as a homogenous sector severely limits the understanding of the intersectoral linkages, and may potentially produce not only invalid predictions, but also unsound policy advice. As an example, consider a negative oil price shock. In most oil-exporting countries, such a shock will result in a depreciation of the currency (to which we will return below). In a two-sector model such as the one analysed in the previous section, the prediction would be that this is good news for the

traded sector, since the depreciation will increase the activity in the sector. This may well be so for the parts of traded sector that are unrelated to the oil sector. In most oil-exporting countries, however, there has been a shift *within* the traded sector away from producing traditional goods towards being more closely interlinked with the oil sector. For this part of the traded sector, it is clearly challenging to argue that a lower oil price is good news. If anything, the opposite is the case, since a lower oil price implies lower activity in the oil sector and reduced investments in oil extraction and exploration, in turn demanding less inputs from the oil supply industry. We thus now extend the approach to a three-sector economy.

The three-sector model is represented in Figure 4. The left and the middle panels reproduce the two-sector model above; the right-hand panel contains the oil supply industry. Here, demand for domestically produced services to the oil sector is decreasing in the price of the services, since this sector competes with alternative suppliers from other countries. The supply from the sector is increasing in the price the sector receives. The price, and the quantity produced by the domestic oil supply industry, are determined by the intersection of the demand with the supply curve in the right panel of Figure 4.

Figure 4 The three-sector model

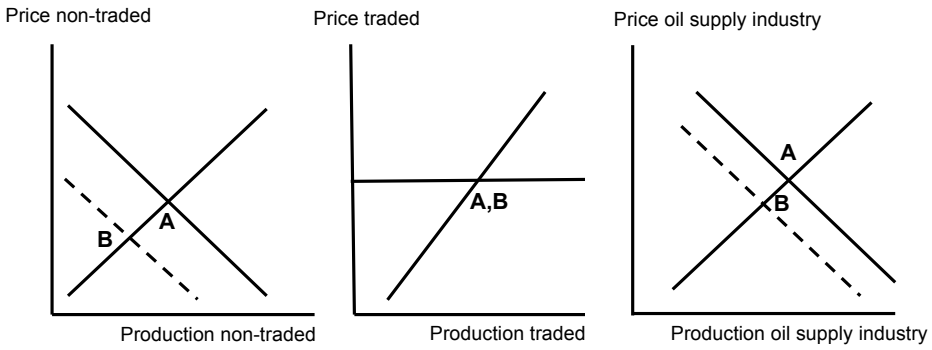


A lower price of oil

Consider now a negative oil price shock. The lower oil price reduces the level of activity in oil extraction, and especially the level of investment in oil extraction, meaning that for any price there is less demand for goods and services produced by the domestic oil supply industry. In Figure 5, this is represented by the leftward shift in the right panel,

moving the price and activity in the oil supply industry from point A to point B. This resource movement effect – i.e. that there are fewer linkages from oil extraction to demand for domestic labour – has the direct effect of producing a contraction in the oil supply industry. This is not the full story, however. Since incomes and employment are reduced in the oil supply industry, the addition of the resource movement effect also implies that the spending effect becomes magnified. The economy moves from point A to point B in the left panel of Figure 5.

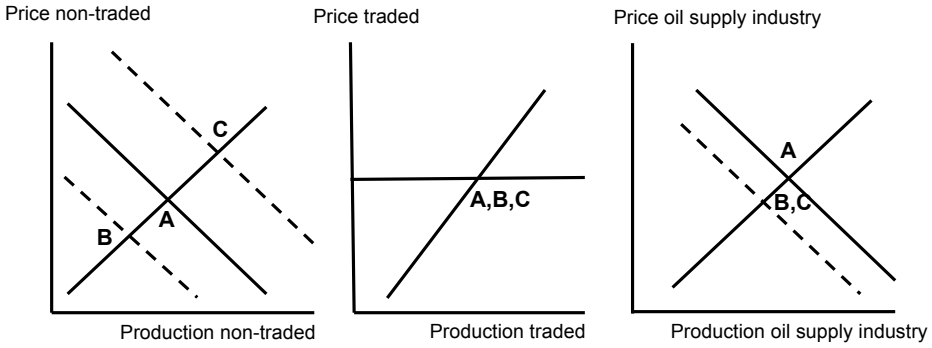
Figure 5 Lower price of oil



Fiscal policy response

Consider now the case where the government aims to combat the contraction with an expansionary fiscal policy, and consider first the case where the fiscal policy is so expansionary that demand for non-traded goods shifts back to its initial position. In Figure 6, we are then back at point A in the left panel of the figure. Is this sufficient to keep aggregate unemployment from increasing? Unfortunately, the answer to this question is no, and the reason is that we still have the contractionary effect of the resource movement effect. In terms of Figure 6, we are still at point B in the middle and in the right panels. Since employment in oil supply industry at point B is still below what is was before the oil price shock, the expansivity of fiscal policy required to avoid unemployment from increasing is stronger. Thus, to be able to combat the increase in unemployment, fiscal policy has to be even more expansionary, moving the demand curve in the non-traded sector to the right, and establishing an equilibrium at a point such as C in the left panel of Figure 6.

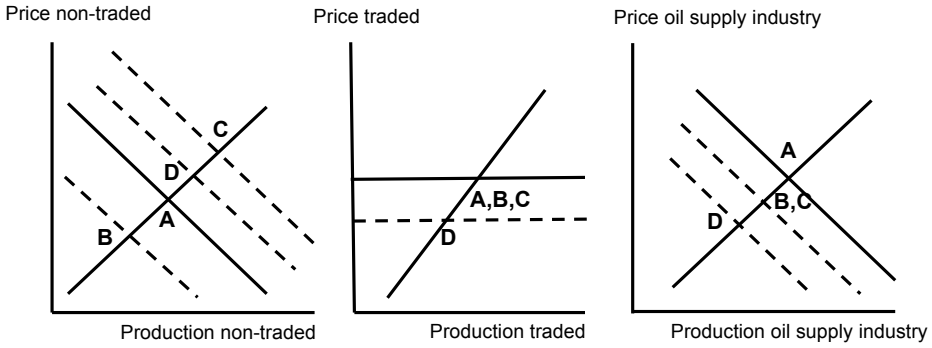
Figure 6 Expansionary fiscal policy



Note, however, that at point C even if employment is back at its original level, the prices of non-traded goods are pushed up. With flexible inflation targeting, this triggers a monetary policy response from the central bank. When the central bank increases the interest rate, the currency appreciates, affecting both the traditional traded sector and the oil supply industry, as seen in Figure 7. In the traded sector, the price curve shifts down to the dotted curve, establishing the equality between the price curve and the supply curve in the middle panel at point D. In the oil supply industry, the appreciation of the currency makes the industry less productive compared to its foreign competitors, shifting the demand directed against the domestic oil supply industry leftwards, pushing production down to point D. In the left panel of the figure, the response in the non-traded sector is shown as the movement from point C to point D. The appreciation of the currency, the lower level of activity in both the traded sector and in the oil supply industry, and the higher interest rate all push demand down.

Note that with flexible inflation targeting, point D has to be to the right of point A in the left panel in Figure 7. To see why this is the case, consider the case where point D in the left panel of Figure 7 is below and to the left of point A. If that were the case, both aggregate prices and aggregate employment would be below target. That, however, cannot be consistent with an optimal monetary policy. The reason for this is that by reducing the interest rate, prices and employment would both move closer to target. This is clearly favourable, and implies that in such a case the interest rate could not have been set at its optimal level in the first place. Thus the interest rate has to be set sufficiently low that point D in the left panel of Figure 7 is to the right of point A.

Figure 7 Expansionary fiscal policy + inflation targeting



To sum up so far, combatting the oil price shock with expansionary fiscal policy destabilises both the traded sector and the oil supply industry. A fiscal policy response expands the economy through a larger non-traded sector.

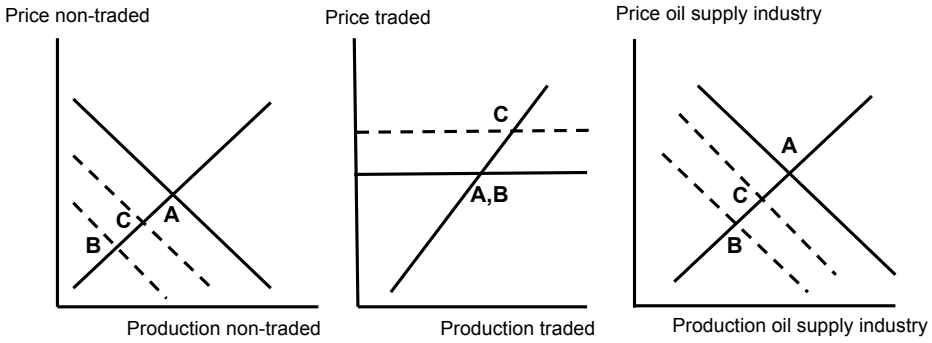
Monetary policy response

Consider now the case where, instead of a fiscal policy response, the oil price shock is met with a monetary policy response. The effects are shown in Figure 8. Again, after the oil price shock, and without any policy response, we have moved from point A to point B in all three panels. The resource movement effect makes employment and production lower in the oil supply industry. The spending effect, magnified by the lower employment and income in the oil supply industry through the resource movement effect, shifts demand in the non-traded sector down. The traded sector is not affected, and points A and B for this sector are therefore identical.

Under flexible inflation targeting, the central bank should not sit still. There are two reasons for this: first, aggregate employment has decreased; and second, prices have decreased. For both reasons, the optimal monetary policy response according to a flexible inflation target is a lowering of the interest rate. The lower interest rate depreciates the currency, making the oil supply industry more competitive and shifting the demand curve towards the right in the right panel of Figure 8. The impact effect from A to B is thus partly stabilised, bringing the activity level in the oil supply industry to a level indicated by point C. In the traded sector, the depreciation of the currency shifts

the price curve up, increasing prices and production from point B to point C. Finally, the resource movement effect leading to increased incomes in the oil service sector (from point B to C), the higher prices and income in the traded sector, the currency depreciation, and the lower interest rate all pull in the direction of increased non-traded demand. The demand curve in the left panel of the figure shifts to the right, pushing the level of activity up from point B to point C. Note that in Figure 8, the monetary policy response can be compatible with a stable aggregate price level, as the prices of non-traded goods have fallen while those of traded goods have increased.

Figure 8 Lower oil price + inflation targeting



Concluding remarks

Petroleum-exporting countries have faced considerable policy challenges due to oil price shocks. In this chapter, I have discussed the challenges related to stabilisation policy. Traditional two-sector models suggest that an expansionary fiscal policy contracts the traded sector, and expands the traded sector. This contributes with the opposite of diversification of the economy.

Extending the traditional two-sector approach to a three-sector model to deal with the domestic oil supply industry strengthens this conclusion. The impact of the oil price shock is now stronger, since the impact works not only through the spending effect, but also through the resource movement effect. The latter adds to the spending effect, making the initial contraction when the economy is hit by a negative oil price shock larger, and the need for a policy response stronger. Again, if such a shock is met with an expansionary fiscal policy, there is the danger that one is putting the economy on a

path that is in a different direction from what is needed over the medium and long term. If the shock is met with a monetary policy response, on the other hand, the economy is put on a path that is more sustainable should the oil price shock turn out not to be temporary.

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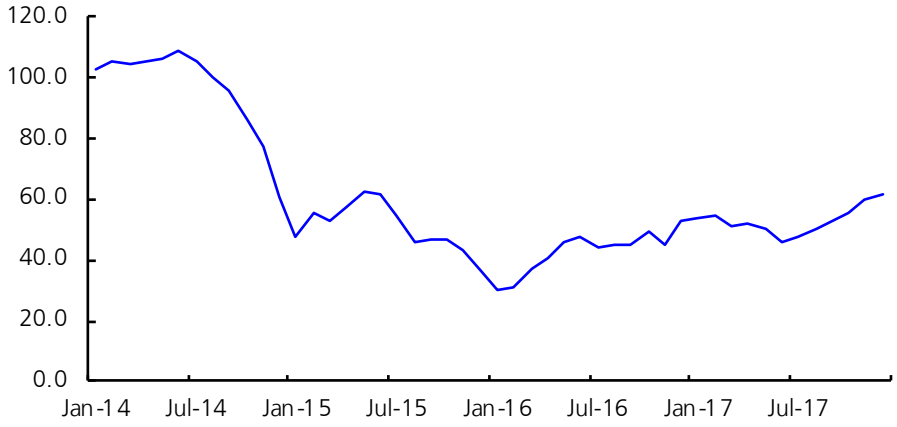
7 Monetary policy in oil-exporting countries: The curse of horizons

Rabah Arezki
World Bank

Introduction

Fossil fuel exporters are exposed to the vagaries of fossil fuel markets. The collapse in oil prices that started in June 2014 is a stark reminder of the challenges posed by a dependence on oil and other fossil fuels (Figure 1). While the literature on appropriate macroeconomic policies for fossil fuel exporters is extensive, much more attention has been paid to the role of fiscal policy. Part of the reason why monetary policy has been less subject to attention may have to do with the fact that most fossil fuel exporters have pegs or relatively fixed exchange rate regimes, and hence have no independent monetary policy. There are, however, good reasons to take a fresh look at the issue of monetary policy in fossil fuel exporters. Traditionally, the horizon of monetary policy has been limited to that of the business cycle (typically, two to six years). Considering the degree of wealth concentration, the strong complementarity between fiscal and monetary policies, and the emergence of new risks to fossil fuel assets, there is a need to rethink monetary policy in fossil fuel exporters. In this chapter, I examine the role monetary policy should play at different horizons.

Figure 1 The 2014-2016 oil price slump



Source: IMF, Primary Commodity Price System.

Note: APSP = average petroleum spot price—average of U.K. Brent, Dubai, and West Texas Intermediate, equally weighted.

In a 2015 speech, Bank of England Governor Mark Carney recently weighed in on the debate over whether monetary policy should look beyond the horizon of the business cycle. Interestingly, part of his argument lies in the risk of financial instability that may result from the 'energy transition' away from fossil fuels, ultimately turning the latter into stranded assets. The transition threatens the financial health of corporations, insurers, and other financial corporations that are exposed to fossil fuel assets. While the overall exposure to fossil fuels in advanced economies like the UK may at first glance appear relatively small, the systemic risk that may result from stranded assets should not be underestimated – recall that the Global Crisis was triggered by developments in the relatively small subprime mortgage market in the US. For fossil fuel exporters, the high degree of concentration of wealth (and risks) around fossil fuel assets makes for an even easier argument (than for diversified economies) that monetary policy should look beyond the business cycle horizon.

The short run

In this section, I explore the choice of appropriate exchange rate regime in fossil fuel exporters. I then discuss the polar views on the appropriate (independent) monetary policy response to a drop in oil prices. I also touch upon the issue of monetary policy transmission.

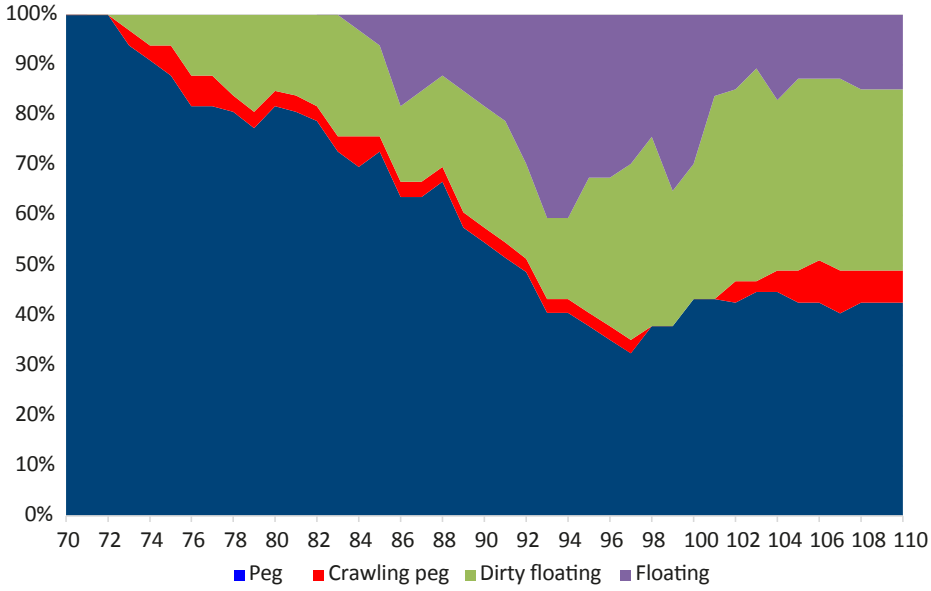
Choice of exchange rate regime

Adopting a flexible exchange rate regime is appropriate in countries where inflation expectations are well anchored. A flexible arrangement allows for an instantaneous adjustment of the nominal exchange rate following a terms-of-trade shock resulting, say, from fluctuations in prices of fossil fuels.

In practice, however, we observe that many commodity exporters are pegging to the currency of their main trading partners (dollar or euro) or have adopted a managed float regime (see Figure 2). There are two main reasons for this. First, a fixed exchange rate regime maintains the parity between the domestic currency and a foreign currency, thus limiting fluctuations in the price of imported goods and inflation – also considering that domestic prices are often sticky. A fixed exchange regime may also contribute to building credibility for monetary policy by anchoring inflation expectations. Second, the lack of exchange rate flexibility has to do with the 'fear of floating'. Indeed, currency mismatch can be fatal and lead to crisis. Hence countries often fear allowing their currencies to float. That said, there are important *risks associated with adopting a fixed exchange rate regime, if the countries run pervasive external deficits* that often stem from internal deficits (so-called twin deficits).

Besides a peg, many countries operate 'managed floats'. This arrangement allows them to choose how much of the adjustment to a terms-of-trade shock should come from exchange rate adjustment versus domestic price adjustment. A terms-of-trade shock amounts to a negative wealth shock, suggesting the real exchange rate has to adjust towards a new equilibrium level. A resource windfall is also typically associated with the 'Dutch disease'. In other words, a positive oil price shock leads to a relative price change between non-oil tradables and nontradables.

Figure 2 Evolution of exchange rate regimes over time



Source: Ilzetzki et al. (2017).

In the case of a pure float, a terms-of-trade shock leads to immediate adjustment of the real exchange rate through the nominal exchange rate when goods prices and wages are rigid. Empirical evidence suggests that flexible exchange rate regimes allow for a smoother real adjustment, that is, lower output volatility.

In the case of a managed float, it might not be desirable to force such a speedy adjustment through the nominal exchange rate, and a managed float allows countries to make a choice of how much nominal exchange rate adjustment and how much (gradual) domestic price adjustment. However, this could come at a cost to the credibility of policies. Fiscal policy could help counteract the effect of a terms-of-trade shock and hence limit the domestic price adjustment or spread it over time. There is also an important issue associated with the 'asymmetrical' nature of the Dutch disease (Arezki and Ismael 2013) stemming from downward nominal stickiness. In these circumstances, it may make sense to resist a nominal appreciation and let inflation increase above target to facilitate this relative price change.

There are also issues associated with capital account openness and the conduct of monetary policy. Brazil is a good example of a country that has struggled with the consequences of a rapid exchange rate appreciation resulting from a surge in capital inflows during the boom in commodity prices.

The two polar views of independent monetary policy

A dilemma for fossil fuel exporters is that an oil price drop may lead to two polar views of what the appropriate response of independent monetary policy should be. On the one hand, a central bank pursuing a (strict) inflation mandate would tighten monetary policy in the face of a drop in oil prices. Indeed, a drop in oil prices would lead to a depreciation in the exchange rate, thus leading to a rise in inflation justifying a tightening of monetary policy. On the other hand, a central bank focused on stabilising output would loosen monetary policy in the face of drop in oil prices. Indeed, an oil price drop would lead to lower demand from the oil sector to the rest of the economy. This in turn would make the output gap of the non-oil economy rise, justifying a loosening of monetary policy. The channels include large backward and forward linkages between the oil and non-oil sectors (for example, in Norway and Russia) and changes in government spending/taxes and the credit channel.

In theory, the new Keynesian framework with wage or good price rigidity offers guidance on the correspondence between targeting inflation and targeting output. In a 'closed economy', so-called divine coincidence – the equivalence between targeting inflation and output stabilisation – holds under the assumption of limited frictions (Blanchard and Gali 2007). In the context of 'commodity openness' (both consumption and production openness), there appears to be no divine coincidence under standard assumptions. Flexible inflation targeting is (constrained) efficient. Research has also shown that headline rather than core inflation targeting is more appropriate in the presence of credit constraints and a large share of food in the consumption basket. Some authors have argued for setting the exchange rate to the domestic currency price of commodity exports. While such a rule would stabilise government oil revenue in local currency, it has no clear welfare rationale.

In practice, most countries loosen monetary policy in the face of a drop in oil prices, suggesting that output stabilisation is more important that strict inflation targeting.

All in all, a peg allows fossil fuel countries to stabilise (imported) inflation and build credibility if the country maintains fiscal discipline (i.e. avoids a pervasive current account deficit). In the case of a float, the central bank should set an inflation target. If inflation expectations are anchored, the central bank can afford to also worry about output stabilisation, that is, loosen monetary policy in a context of negative terms-of-trade shock. If inflation expectations are not well anchored (because of limited credibility) and if the share of imported goods in the consumption basket is large, a tightening of monetary policy in the face of a negative terms-of-trade shock may be warranted.

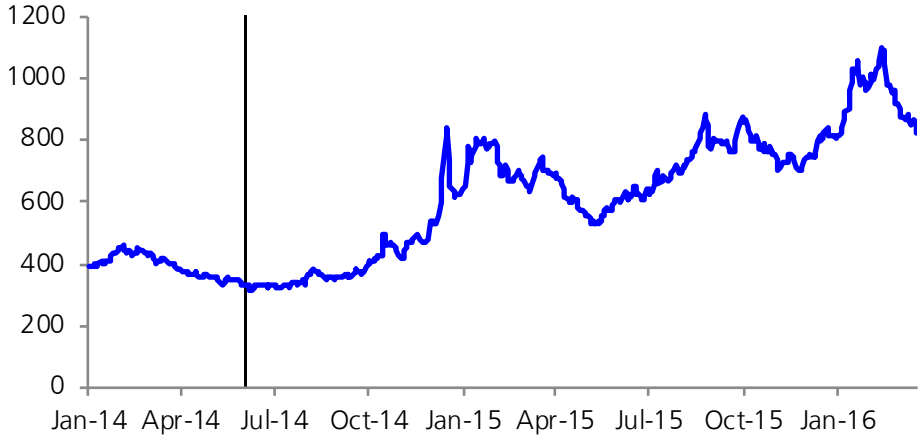
The medium run

In this section, I examine the role monetary authorities should play beyond the business cycle horizon. First, I explore the issue of complementarity between fiscal and monetary policy in fossil fuel exporters. I then discuss the need for macroprudential policies. Finally, I draw lessons from the recent collapse in oil prices and the associated policy responses.

Complementary between fiscal and monetary policy

Commodity-exporting countries – and fossil fuel exporters are no exception – tend to overspend in good times, leading to excessive indebtedness and crisis in bad times. The effectiveness of the contribution of central banks toward stabilisation thus rests on the existence of a credible/sustainable fiscal anchor. The cost of borrowing rise with falling commodity export prices (Figure 3). Weaker political institutions typically make things worse, considering the risk premium emanating from weak institutions. There is a need for fiscal (and credit) rules to limit the amplification of the effect of terms-of-trade shocks. Interestingly, many countries have graduated from pro-cyclicality by setting up fiscal rules. The differentiated macroeconomic impact of oil shocks on Mexico and Norway can be explained by differences in their degree of fiscal discipline.

Figure 3 Rising sovereign bond spreads (average J.P. Morgan EMBIG Sovereign Spread Index)



Source: Bloomberg, L.P.; and IMF staff calculations.

Note: Oil exporters are comprised of Angola, Bolivia, Colombia, Ecuador, Gabon, Iraq, Kazakhstan, Nigeria, Russia, Trinidad and Tobago and Venezuela.

Trinidad and Tobago and Venezuela.Chile provides an example of a commodity exporter that has set up a fiscal rule and graduated from pro-cyclicality. An independent council of expert determines the 'volume' of spending, while members of parliament decide on the 'composition' of spending by picking projects that have been pre-screened by a fiscal authority. The presence of a fiscal rule in Chile has arguably supported the implementation of monetary policy, and specifically inflation targeting. Short of building the needed constituency to set up and implement a fiscal rule, Mexico has settled for a large-scale hedging programme against oil price volatility. Of course, the difficulty with hedging programmes is the tension that may arise over the perceived excessive cost of the programme during boom times. To allay this concern, the Mexican programme has been designed to capture the uptick from high oil prices using Asian options. It should be noted, however, that both tools – fiscal rules and hedging programmes – are often politically difficult to implement.

Macroprudential policies

Credit and asset prices in commodity exporters tend to amplify macroeconomic fluctuations. The concentration of wealth in one sector makes concerns over systemic risk much more prevalent in commodity exporters. Macroprudential tools are thus all the more important in these economies to help limit the amplitude of boom and bust cycles in credit and asset prices (stocks, real estate prices, etc.) and hence reduce the risk of financial instability.

The IMF recommends that these tools – which are commonly used separately – be used coherently to limit perverse and countervailing effects. The most common prudential tools include capital buffers, risk-based supervision, time-varying loan-to-deposit ratios, and loan-to-value ratios. Sector-specific tools aim to limit the sectoral exposure, particularly for real estate and personal loans. Other efforts to limit systemic risk include liquidity management, the development of domestic interbank money, and debt markets. The modernisation of insolvency regimes and strengthening crisis management and resolution systems are also areas where progress is needed in many fossil fuel exporters.

Lessons from the 2014-16 oil price collapse

The policy response to the spectacular oil price collapse has been quite different across countries. Conceptually, one needs to distinguish between countries that have buffers and those that have none. Those with buffers should use them to adjust gradually to the medium anchor. Those with no buffers have no choice but to let the exchange rate depreciate. In practice, the differences in responses reflect different countries' circumstances, including the presence of buffers but also the share of imported goods in total domestic demand – 11% for Russia compared to 40% percent for the Gulf Cooperation Council (GCC), for example. Russia and Azerbaijan have either devalued or let their currency depreciate early on (with some risks of currency mismatch). Inflation from imported goods, in turn, pushed the central bank to raise rates. GCC countries have kept their peg unchanged, reflecting their very large share of consumption concentrated around imported goods and their open capital account. On the fiscal front, however, many GCC countries have embarked on ambitious reform programmes (i.e.

subsidy cuts) to reduce spending and also diversify their economies (for example, Saudi Arabia's 2030 plan). Nigeria had initially opposed a devaluation of its currency and hence losing most of its reserves and leading to an explosion of the black market premium. The authorities recently opted for a devaluation and a (managed) float.

The key lesson in the medium run is that the choice of monetary policy is influenced by the structure of the economy, including the sustainability of fiscal policy (relating to depleting reserves, the share of imported goods in aggregate demand, credibility, polarisation, and so on). Considering the choice of exchange rate regime, fiscal policy can help buffer and smooth the adjustment to a terms-of-trade shock. Macroprudential policies can help limit credit and asset price booms and busts, and currency mismatch.

The long run

The historic COP21 agreement to keep global warming below 2° Celsius and technological innovation (declining cost of renewables, electric cars, etc.) have further boosted the energy transition away from fossil fuels. That means that gigatonnes of reserves will have to remain unexploited underground. Although the risk of stranded assets for fossil fuel exporters appears to be remote, it does pose an existential threat that monetary authorities cannot afford to ignore. It is not easy to define the contours of how monetary authorities should engage on these issues, which appear structural in nature, but considering that they pose a systemic risk, it is urgent that authorities take up the challenge of rethinking their role in the light of these new risks.

Stranded assets

To keep mean global surface temperature below 2°Celsius, only 300 to 400 gigatonnes of carbon can still be burnt, but reserves of private oil and gas majors only are at least three times as high. To abide by international commitments to limit global warming, a third of oil, half of gas, and 80% percent of coal reserves should be kept in the ground forever (McGlade and Ekins 2015). This would mean leaving unburned one third of oil reserves in Canada and the Arctic, and 50% of gas and 80% of coal reserves (mainly in China, Russia, and the US). In the Middle East, reserves are three times larger than

the region's 'carbon budget', implying that 260 billion barrels of oil in Middle East cannot be burnt. In addition to stranded reserves, the structures and capital used in the extraction and exploitation of fossil fuels can also become stranded.

What can be done about stranded assets?

Obviously, many fossil fuel exporters have been concerned with the need to diversify their economies. However, very few have successfully moved away from their dependence on fossil fuel. The regulatory and technological changes sweeping the energy market may make this a more urgent priority. To help structural policies, working at the longer end of the yield curve would facilitate longer-term investment and diversification. The response to the risk of stranded assets may have a bearing on the asset allocation of fossil fuel exporters. Many oil exporters have accumulated vast financial assets, and the strategic allocation of these is all the more important considering the new risks. Investing away from financial assets that are based on fossil fuels is an obvious policy.

One implication of the spectre of stranded assets is that they could lead to a race to burn the last tonne of carbon. This could in turn lead to the so-called green paradox whereby regulation aiming to limit carbon emissions ends up raising emissions, at least in the short run. Some commentators have argued the collapse in oil prices results from a deliberate attempt on the part of major oil exporters with low marginal cost of production to both crowd out higher marginal cost producers and also to delay the energy transition. There is indeed evidence that low fossil fuel prices can potentially delay the transition.

All in all, the risk of stranded reserves and capital is much greater for fossil fuel exporters than for advanced economies. Monetary policy needs to reflect and communicate on this existential threat and advocate that appropriate structural policies are adopted to diversify the economy. It should also provide supportive financial policies to help the diversification and adapt the allocation of strategic assets.

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Mr. Arezki is the co-editor, and co-author of four books including *Beyond the Curse: Policies to Harness the Power of Natural Resources, Commodity Price Volatility and Inclusive Growth in Low-Income Countries, Shifting Commodity Markets in a*

Globalized World, and *Coping with the Climate Crisis: Mitigation Policies and Global Coordination* (forthcoming).

Many of Mr. Arezki's research papers have been cited extensively in academic circles and in prominent media outlets such as the *Economist,* the *Financial Times*, the *New York Times*, the *Wall Street Journal*, *Project Syndicate*, and the *Washington Post*. His blog posts including on the recent oil price collapse and its global economic consequences have been viewed over hundred thousand times and have been listed as the most read IMF blog posts three years in a row. Mr. Arezki is also a frequent contributor to *Finance and Development* magazine, VoxEU, an associate editor of the *Revue d'Economie du Développement* and was until recently the Editor of the *IMF Research Bulletin*.

A dual citizen of Algeria and France, Mr. Arezki received his M.S. from the Ecole Nationale de la Statistique et de l'Administration Economique in Paris, M.A. from the University of Paris-1 Pantheon-Sorbonne and Ph.D. in economics from the European University Institute, Florence.

PART III

Finance and Diversification

8 Finance and resource booms: A complicated relationship

Thorsten Beck
Cass Business School and CEPR

Natural resources are seen both as a source of wealth for nations and as a possible curse. On the one hand, natural resources constitute an important share of wealth for many nations across the globe, with the challenge being to transform them into other forms of wealth; on the other hand, an extensive literature has shown the lower long-term growth path of countries with higher natural resource wealth, a phenomenon referred to as the natural resource curse.

While an extensive literature has documented a natural resource curse for education, manufacturing, democratization, and institution building, only a few papers have considered the relationship between natural resource wealth and the financial sector. This chapter summarises several recent studies in this area.

Finance is important for growth…

Countries with deeper financial systems grow faster, and it is the lowest income quintile that benefits most from this deepening (Beck et al. 2000, Beck et al. 2007). Countries with deeper financial systems also experience faster reductions in income inequality and poverty rates. The importance of financial deepening for economic growth has been shown to be strongest among middle-income countries, where the financial system is large and sophisticated enough to have an impact on the real economy but it still focuses mainly on intermediation business, unlike in many high-income countries (Arcand et al. 2015, Rioja and Valev 2004a,b).

… and natural resources can hurt growth

The natural resource curse refers to the crowding out of non-resource-based activities or investment through price and incentives effects. One form – referred to as Dutch disease – works through the exchange rate mechanism: commodity exports will put upwards pressure on the real exchange rate, which will turn non-resource exports uncompetitive, ultimately depressing the traded goods sector. Beyond price effects, the natural resource curse also refers to the distortion of incentives for investment in institutions, education, and other public services due to windfall gains from natural resources, as well as negative repercussions for political freedom and stability. It is generally easier to materialise short-term profits from natural resources such as oil than from fixed assets such as manufacturing plants, equipment, and machinery, because proceeds from natural resources depend less on the creation of a market, on human capital, and on R&D investment. This in turn reduces incentives to invest in an institutional framework that supports broad domestic market-based exchange, private property rights, and the contractual framework supporting non-commodity production (Besley and Persson 2010).

Natural resources and finance: Theoretical considerations

The literature on the natural resource curse provides different hypotheses on the effect of natural resource abundance on financial system development. On the one hand, windfall gains from natural resource abundance and the consequent expansion of the non-traded goods sector can lead to higher demand for financial services, including consumer credit. Such a virtuous cycle would lead to the additional resources being intermediated through the financial system, to the benefit of consumers and enterprises, including firms in non-resource sectors. On the other hand, higher investment in the natural resource sector can lead to lower investment in the financial sector and draw away skills from the financial system. Such a 'brain drain' would undermine financial sector development in resource-rich countries. In addition, the heavy dependence of the financial system on a sound institutional framework, including an effective contractual framework, can hamper financial deepening in countries where natural resource abundance undermines institutional development. However, one also has to consider

the demand side. There is certainly a lower demand for external financing from the natural resource sector than from non-resource traded goods sector, which will suffer in a Dutch disease scenario. Further, the literature has documented lower savings rates in resource-based economies, which in turn can also explain a lower demand for financial services in resource-based economies.

A separate discussion is on whether we can expect similar effects in the relationship between financial development and economic growth for resource as for non -resource-rich countries. On the one hand, the financial system might be less important, as growth depends less on finance-intensive sectors. On the other hand, financial system development might be more important to compensate for the negative effects of Dutch disease and in order to diversify the economy. In addition, financial systems in resource-based economies can help counter the negative impact of real exchange rate volatility (Aghion et al. 2009).

Measuring natural resource wealth

The literature has used different indicators to measure the reliance of economies on natural resources, ranging from the export share of natural resources in total exports or relative to GDP to the importance of subsoil wealth in a country's total wealth and giant oil field discoveries. However, these measures these have been criticised for their lack of exogeneity, as they are based not only on exogenous geology but also on exploration effort, technology, and extraction costs (and thus growth and institutions) that determine the degree of economic recoverability of resources.[1] Recently, also the likelihood of giant oil and gas field discoveries have been shown to depend on the quality of institutions, because exploration effort relies on the quality of institutions (Tsui 2011, Arezki et al. 2016), which might result in a vicious cycle of institutional underdevelopment, low likelihood of resource discovery, and low economic development.

One way to address this endogeneity challenge is to isolate windfalls arising from unexpected and exogenous world price changes that affect a country's effective natural

1 See for example the discussion in van der Ploeg and Poelhekke (2010).

resource export prices from those arising from increased production or from reduced unit production cost, as suggested in Beck and Poelhekke (2018). My co-author and I base our indicator on the World Bank (2011) data set on resource rents, which is defined as revenue net of extraction costs for the total of metals and mineral produced (including oil, gas, coal, bauxite, copper, lead, nickel, phosphate, tin, zinc, gold, silver, and iron ore) and is available up to 2008. Specifically, we split the log change of resource rents into (i) the log change in the Paasche price index of metals and minerals, with base year 1970, to capture windfalls due to exogenous world price shocks; (ii) the log change in metal and minerals revenue (value of production) divided by the Paasche price index of metals and minerals, which indexes windfalls due to changes in production; and (iii) the log change in Paasche unit production cost index of metals and minerals, with base year 1970. Only the first component can be seen as completely exogenous for individual countries.

Evidence on the relationship between natural resource wealth and finance

The empirical literature on the relationship between natural resource wealth and financial development is a nascent and still small one. In Beck (2011), I provide some evidence for a natural resource curse in finance, using an array of different data sources on the country, bank, and firm level. Specifically, I show that financial systems in resource-based economies (captured by either resource exports to GDP or subsoil assets per capita) are less developed and banks are more liquid, better capitalised and more profitable, but give fewer loans to firms. Firms in resource-based economies use less external finance and a smaller share of them use bank loans, although there is the same level of demand as in other countries, thus pointing to supply constraints.

Bhattacharya and Hodler (2014) relate the level of natural resource rents as a share of GDP to the level of financial development (private credit over GDP), with both averaged over five-year periods. They instrument rents over GDP with a country-specific price index of commodities using panel data covering the period 1970 to 2005 and 1870 to 1940, and 133 and 31 countries, respectively. They also find that resource revenues are associated with lower financial development in countries with poor political institutions,

but not in countries with comparatively better political institutions. This underpins that the natural resource curse in finance does not come by itself!

These cross-country results, however, do not allow any causal inference from natural resource wealth to underdeveloped financial systems. In Beck and Poelhekke (2018), we therefore use the relationship between changes in resource rents caused by price changes (which can be assumed to be exogenous for individual countries) and changes in deposits and lending by financial institutions using annual data. We find a relative decline in financial sector deposits in countries that experience an unexpected natural resource windfall as measured by shocks to exogenous world prices. Moreover, we find a similar relative decline in lending, which is mostly due to the decrease in deposits. It is important to stress that this is a relative reduction, i.e. countries with increases in GDP due to natural resource windfalls gains experience lower increases in deposits and loans compared to countries with similar increases in GDP due to non-resource growth. The smaller role for the financial sector in intermediating resource booms is accompanied by a stronger role of governments in channelling resources into the economy, mostly through higher government consumption, but also captured in higher government deposits with banks. It is important to stress that this result is driven by countries with less-developed institutions and more repressed financial systems, stressing the triple whammy that financial systems in many low-income countries are suffering from: natural resource dependence, limited institutional capacity, and regulatory frameworks that aim at suppressing financial sector development rather than supporting it.

Finance and growth in resource countries

Using cross-country regressions and industry-regressions à la Rajan and Zingales (1998), in Beck (2011) I find that the finance and growth relationship is as important for resource-based economies as for other economies, so that the under-investment in the financial sector will have long-term negative repercussions for economic growth. Barajas et al. (2013), on the other hand, show that there might be a differential effect if one considers panel rather than cross-country regressions, with financial development having a lower, if not negative, impact on growth in oil-exporting countries. Specifically, they find that the growth impact of banking depth is weaker for oil exporters in general, and is progressively weaker as the degree of oil dependence increases. However, there

is evidence that the growth impact of stock market depth may actually be higher in oil-exporting countries.

Nili and Rastad (2007) report results that are consistent with both these strands of the literature. Specifically, they explore why growth rates experienced by oil exporters over a 30-year period are lower than in oil-importing countries even though their investment rates are higher on average. They find that finance helps to explain the puzzle in two ways: oil exporters tend to exhibit lower financial depth, and the positive impact of their financial depth on aggregate investment – and presumably on growth – is substantially weaker than in non-oil exporting economies.

Conclusions

The evidence so far has provided some evidence that (i) financial development is as important for economic growth in resource-rich countries as in other countries, and (ii) there is a natural resource curse in financial sector development. However, this is only a first step in what promises to be a rich research and policy agenda. First is the question of policies and institutions to overcome the natural resource curse in finance. Is it a question of overcoming the resource curse in institutions, i.e. ensuring that the necessary institutions for an effective and stable financial system are in place in resource-rich countries or are additional reforms necessary? To which extent can such reforms and institution building be undertaken in what are often politically not conducive structures for such reforms? What is the role of government in such reforms, given that they might go counter to the interests of the government or the elites it represents? Or is there a need to rely more on private actors and/or supranational players?

A second important question is the extent to which recent regulatory reforms have to be adjusted to circumstances in resource-rich economies. Specifically, post-2008, there has been a significant push towards stronger capital requirements, the introduction of liquidity requirement, and an increasing role of macroprudential regulatory tools. The latter might be a tool box that is more important for resource-rich countries than others, given the higher volatility in resource-related revenues, and therefore in deposits and lending.

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9 Three funds for managing natural resource wealth

Rick van der Ploeg
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The classical policy prescriptions for managing oil and gas windfalls are based on the permanent income hypothesis: none of the windfall should be invested at home, so all revenue is invested abroad, preferably in an independently managed intergenerational sovereign wealth fund (SWF). Saving and withdrawals of the fund are dictated by smoothing the consumption dividend across different generations, which implies borrowing ahead of the windfall, saving during the windfall, and drawing a constant dividend from accumulated assets in the fund after the windfall. This classical policy prescription also implies that the time path of the real exchange rate must be smoothed to avoid big fluctuations in the sizes of the traded and non-traded sectors of the economy. However, this advice does not speak to the specific challenges facing oil/gas-rich developing countries which have to cope with volatile commodity prices, capital scarcity, and low investments in the domestic economy.

In this chapter, I argue that volatile commodity prices require saving of precautionary buffers, which must be put in a separate stabilisation fund alongside the intergenerational fund. I also argue that with imperfect access to international capital markets, the windfall must be used to curb capital scarcity, bring the cost of borrowing down, boost domestic investment, and bring consumption forward from future relatively rich to current relatively poor generations.

Classical policy prescription: The Case for an intergenerational sovereign wealth fund

Consider a small open economy with one homogenous good that is consumed and invested in capital and is traded freely on international capital markets. Suppose perfect access to international capital markets, constant production income is and an exogenous and time-varying oil and gas windfall. Policymakers maximise utilitarian welfare. The first result is that the return on physical capital must equal the return on foreign assets, and thus that the optimal value of the capital stocks does not depend on the windfall at all. The windfall should thus not be used for investing in the domestic economy, as with access to perfect capital markets investment should already be at its optimal level. The second result states that growth in real consumption depends on the return on assets relative to the pure rate of time preference. If the pure rate of time preference is set to the return on assets, this gives full smoothing of the time paths of consumption. The change in consumption is thus a constant fraction of the change in resource wealth (the present value of current and future resource revenue). Also, the country borrows ahead of an anticipated windfall and saves during a temporary windfall. A permanent windfall has no effects on foreign asset accumulation. Temporary windfalls are thus accumulated in an intergenerational saving sovereign wealth fund.

What does this imply for the recent crash in the oil price? If policymakers believe that the crash is permanent, they should depress current and future consumption by the full whack of the windfall. This means cutting private consumption (by cutting transfers) and cutting public consumption permanently. If policymakers believe the oil price will recover, they will borrow and cut present and future consumption by a smaller amount.

Volatile windfalls: The case for a stabilisation sovereign wealth fund

I have indicated the need for an *intergenerational* SWF to spread the benefits of oil and gas windfalls evenly across generations. Here I advocate the additional need for a *stabilisation* SWF to cope with volatile oil prices and windfalls. Although one can hedge such risks away using futures markets, such markets often do not exist or are too thin and costly. Besides, few ministers of finance are prepared to take the political

risk of hedging, as the electorate may have little sympathy for spending lots of public money on hedging when there are other pressing needs. A stabilisation SWF then allows the country to accumulate prudent buffers. The argument relies on an additional prudence component caused by the uncertain nature of the windfall, which makes the consumption path tilt upwards even if the rate of time preference equals the return on assets. Precautionary saving thus gives a buffer against large negative shocks. There is a lot of precautionary saving if volatility, risk aversion and prudence are high. The resulting revenue should be collected in a stabilisation SWF. Since the optimal size of the intergenerational SWF is larger the more temporary the windfall, whilst the stabilisation SWF is bigger the longer lasting the windfall and the more persistent oil price shocks, the intergenerational SWF pales into insignificance for, say, Iraq with oil reserves potentially lasting for centuries, but the opposite is true for Norway, whose oil and gas revenues taper off quickly in the next decades.

The derivation of prudent saving buffers can be integrated with a capital asset pricing model (CAPM) to allow for stochastic returns on a host of financial assets as well as volatile oil prices. The portfolio allocation should then hedge against commodity price volatility, the demand for risky assets should be leveraged up and gradually deleveraged as oil and gas reserves are depleted. There should be more prudential saving if the oil price cannot be fully diversified on international asset markets. Requiring the fund to go short in risky assets when oil and gas reserves are still high may lead to political obstacles. A more pragmatic approach that avoids heavy borrowing to hedge the oil and gas wealth in the ground and targets a general equity index (e.g. the FTSE index) must realise that portfolio allocation above the ground accentuates the risk of oil and gas wealth in the ground, as since 2008 returns on oil have become positively correlated with stock market returns. Since such a pragmatic approach avoids hedging with specific financial assets whose returns are negatively correlated with below-ground oil and gas wealth, it has to hold *less* risky assets (equities) than suggested by the normal CAPM model and gradually *increase* holdings of risky assets to their normal levels as oil and gas wealth is depleted. Less prudential saving buffers and a smaller stabilisation fund are required if the country can hedge commodity price risks using financial derivatives such as forward contracts or put options. The welfare gains from using such instruments results from a reduction in export revenue volatility, the need for less precautionary buffers, and the enhanced ability of the country to borrow against

future income from commodity exports amounts to several percentage points of annual consumption. This hedging is used in Mexico, where laws are in place to regulate how the derivatives should be used.

Capital scarcity: Using windfalls to boost domestic investment

Many developing economies find it hard to borrow and struggle with sub-optimally low levels of private and public investment. For those countries, oil and gas windfalls can provide a once-in-a-lifetime opportunity to boost domestic investment and thus promote growth and development. To illustrate this, assume that the country is indebted and faces a risk premium on borrowing that increases with foreign indebtedness. Investment is low compared with what it would be if there were access to perfect international capital markets and no risk premium had to be paid. Investment increases if debt reduction curbs the cost of capital. It can be shown that a temporary increase in oil and gas revenue boosts both foreign assets and the capital stock. Part of a temporary windfall is thus saved and, different from before, part of it is used to invest in the domestic economy and promote growth and development. An anticipated future windfall leads, in contrast, to falls in foreign assets and the domestic capital stock. The optimal response to an anticipated windfall is thus to borrow more on international markets to boost consumption ahead of the windfall. It is the extra borrowing that aggravates capital scarcity, pushes up the cost of borrowing for domestic investment projects, and thus curbs domestic investment. A permanent windfall boosts foreign assets and the domestic capital stock. It is thus used to curb indebtedness and bring down the cost of domestic borrowing, which helps to bring domestic investment closer to its optimum. Both current and future consumption increase; as a result of the debt reduction, the ratio of future to current consumption falls. Hence, the windfall is frontloaded towards present consumption, because current generations are poorer than future generations and have a higher marginal utility of consumption. Finally, the effects of a crash in oil prices is to increase debt and borrowing costs, which leads to a drop in domestic investment.

There are other factors behind why investment is sub-optimally low and why it is justified to spend part of the windfall on domestic investment. If international capital

markets factor in political uncertainty and hold back investment in the economy, it makes sense to use part of the windfall to boost domestic investment. However, with political uncertainty there is the danger that the windfall is used to boost partisan investment which does not necessarily enhance growth.

Following a commodity price crash, the real depreciation and fall in the price of non-tradables induces a drop in gross national product (GNP) and thus curbs the collateral and borrowing ability of the country. Dutch disease effects operating in reverse can thus aggravate borrowing and capital scarcity. These collateral constraints lead to sudden stops, with dramatic effects on the current account and a slower extraction of the natural resource, especially when policymakers are learning about whether the drop in the international commodity price is permanent or not.

Concluding remarks

The benchmark prescription for managing oil and gas windfalls is the permanent-income rule: all of the revenue should be invested abroad and preferably managed by an independent intergenerational SWF, and judicious use of borrowing and saving policies should smooth the time paths of private and public consumption and the real exchange rate. This mitigates big swings in the relocation of factors of productions from the sectors producing non-tradables and tradables. A *temporary* windfall, whether it is anticipated or not, if managed by a permanent-income rule, thus leads to a modest *permanent* appreciation of the real exchange rate, a contraction of the traded sector, an expansion of the non-traded sector and an increase in private and public consumption. These policies, however, make little sense for resource-rich developing countries.

First, developing countries have less access to future markets and financial derivatives and must make more use of a stabilisation fund and precautionary saving to cope with the stochastic volatility of commodity prices and their windfalls. Consumption thus cannot be as high in the early stages as in the later stages of development to make room for precautionary saving. A longer-lasting windfall requires a bigger stabilisation fund, but a smaller intergenerational fund.

Second, developing countries have worse access to international markets and suffer from high borrowing costs and insufficient levels of investment. A windfall should then be used to cut the cost of borrowing, alleviate capital scarcity, boost investment in the domestic economy, and promote economic development, but also to frontload the increase in consumption towards current, relatively poor generations. Investing all windfall revenue in foreign assets is therefore a bad idea.

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10 From economic diversification to growth

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University of Iceland

Introduction

Keeping all of one's eggs in one basket is seldom a sound proposition.

Economic diversification away from excessive dependence on a single dominant sector or a few (typically natural resource-based) commodities, including change towards increased complexity and increased quality of national output, is of value because it reduces the risks and vulnerabilities associated with a narrow economic base, and it enhances a nation's ability to produce high-quality items that other nations may wish to buy. Well-diversified economies tend to be more efficient as well as more open to trade, and thus tend to have a greater capacity for rapid long-run economic growth. One way of viewing the beneficial effects of economic diversification on growth is through the widely observed inverse relationship, both across as well as within countries, between heavy dependence on a few natural resources and long-run growth.

Natural resource management policies aiming at economic diversification and avoidance of risk reflect the need to manage common property resources in ways that avert the 'tragedy of the commons' – i.e. the danger of overuse and pollution, including global warming, due to unregulated economic interests. Without appropriate incentive structures in place, private parties or public entities, or even entire nations, may have an interest on selfish grounds in despoiling natural resources, such as fish

1 This chapter is derived from the author's presentation at a High-level Seminar on *Natural Resources, Finance, and Growth* organized by the Bank of Algeria and held in Algiers 28-29 May 2016.

species in international waters or fresh air. It takes government action and international collaboration to put in place incentive structures that align private interests with the public interest and with the interests of the world community at large. For this reason, economic diversification policies may prove to be intertwined with efficient and fair responses to the overexploitation of common-property natural resources. Along these lines, the recent call by the heads of the IMF and the World Bank for carbon pricing to mitigate climate change echoes the arguments long advanced by economists for market-based solutions for cleaning up the environment.

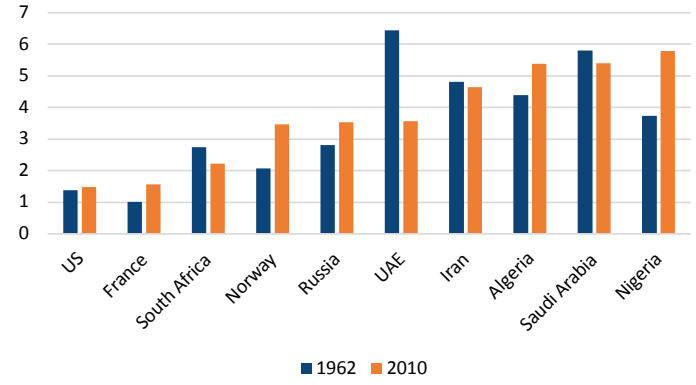
This chapter briefly describes economic diversification as one of several potential drivers of sustained economic growth. Space does not permit the consideration of *economic* and *political* diversification side by side, where political diversification refers to the democratisation of political processes aiming to reduce the risks and vulnerabilities associated with excessive dependence on a narrow political base. Let it suffice here to assert that political diversification can be gainfully viewed as the twin sister of economic diversification.

Economic diversification, quality, and complexity

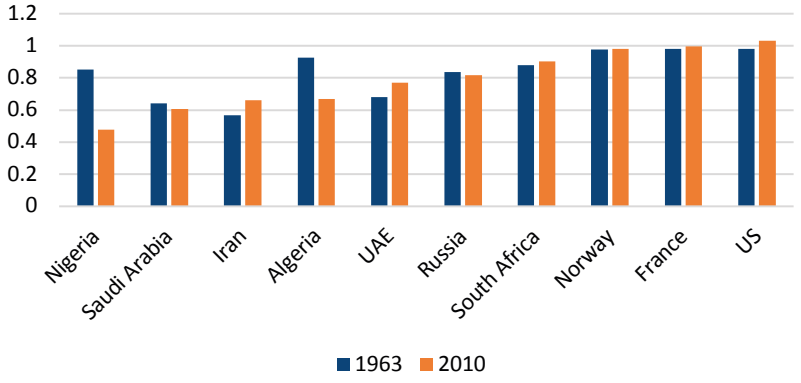
There are several ways to assess economic diversification, including the well-known Finger-Kreinin index of export diversification and the Herfindahl-Hirschman index of market concentration, both published by UNCTAD. Here, however, I review recent measures of export diversification and product quality developed by the IMF. The IMF has constructed an Export Diversification Index (EDI) based on the Theil index, a common measure of inequality, segregation, and other forms of diversity. The Theil index – unlike, for example, the Gini index of inequality – is designed to reflect diversity within as well as among sectors and groups. Specifically, the Theil index equals the sum of measures of diversity across sectors (vertical diversity or extensive margin, meaning new export products or new export destinations) and diversity within sectors (horizontal diversity or intensive margin, meaning a larger volume of exports of old products). The more diversified a country's exports, the lower the EDI.

Figure 1 Measures of economic diversification

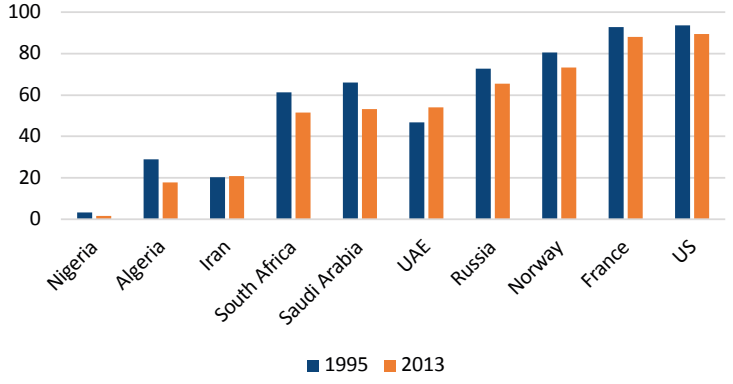
a. Theil Export Diversification Index (EDI)



b. Product Quality Index (PQI)



c. Economic Complexity Index (ECI)



Source: Author´s computations based on data from IMF (Panels A and B) and Atlas of Economic Complexity (Panel C). Higher columns denote less diversification in Panel a, and more diversification in Panels b and c.

One reason why export diversification is generally considered desirable, apart from considerations of risk, is that it helps promote the emergence of high-quality exports (i.e. exports with high unit value). The idea here is that in addition to what and how much a country exports, to whom the exports are sold also matters. Put differently, geographic diversification is desirable in addition to economic diversification in that selling the same product to several different customers spreads risk in a similar way as selling several different products to the same customer. Along these lines, the IMF has also recently produced time series intended to measure the average quality demanded in an exporter's current destination markets for a product, where a value of 1 characterises an exporter whose exports of a given product go to destinations that demand a high quality of that product, on average, in their imports. The product quality index (PQI), produced through elaborate modelling, ranges from 0 (low quality) to 1.2 (high quality). Hence, higher quality of exports is reflected in a larger value of the PQI. The EDI and the PQI for ten countries, including seven net oil exporters, are shown side by side in Figures 1a and 1b.

Because they cover only goods and not services, the IMF measures shown in Figure 1 tell only a part of the story of economic diversification. This matters because the economic diversification strategies of many countries focus increasingly on branching out into services, by far the world's largest economic sector measured either in terms of manpower or share in total output. The argument that diversification reduces risk also applies to services and to tangible goods. Further, the expansion of services can be a strong catalyst for goods exports, directly as well as indirectly through spillover effects. Disaggregated statistics on services – enabling statisticians to measure the diversification, concentration, and quality of services – remain to be compiled and analysed. Economists at the IMF are presently working on compiling an international database on services to expedite a balanced coverage of goods and services exports in studies of economic diversification.

Related to the IMF measure of product quality, there is yet another way of looking at export diversification (Figure 1c). The Economic Complexity Index (ECI) ranks countries by the diversity and complexity of their export structure. The most complex products are sophisticated chemicals and machinery, while the least complex products are raw materials and simple agricultural products. Countries that produce complex

goods as well as a large number of products are typically more advanced or likely to experience more rapid economic growth in the future than countries producing fewer and less complex products. If so, the ECI can be used to assess economic development. The consideration of economic complexity adds a potentially useful dimension to the analysis of economic diversification. Greater economic complexity is reflected in a higher value of the ECI as defined here. In Figure 1c, the original ECI rank has been converted to an index representing the relative ranks of the ten countries by the formula 100*(1 – rank/124) where 124 is the number of countries included in the ranking. The number of countries covered by the ECI was 121 in 1995 and 124 in 2013. The more complex the products, the larger the index.

From economic diversification to growth

There is some empirical evidence suggesting that economic diversification and long-run economic growth tend to go together over time as well as across countries, partly because diversified economic activity and diversified exports reduce risk and instability, thus strengthening the foundation of economic growth over time. Figure 2 shows the cross-country relationship between different measures of economic diversification and long-run growth. In Figure 2a, we see how the Theil index of export diversification developed by the IMF goes along, in an economically as well as statistically significant way, with per capita gross national income (GNI) adjusted for purchasing power (interpreted as an indicator of past economic growth on the grounds that a country's income today reflects its economic growth performance in the past). Figure 2a shows a significantly positive cross-country correlation between the average value of the Theil index of economic diversification and the natural log of per capita GNI in a sample of the 164 countries for which data are available, not including the six Gulf Cooperation Council (GCC) countries (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and United Arab Emirates) that are characterised by high per capita incomes and low diversification. We see how per capita incomes and diversification go hand in hand from bottom-left to top-right. If Figure 2a is taken to suggest that diversification is a determinant of growth rather than the other way round, and if the slope of the regression line shown (-0.57) is taken at face value, the regression coefficient suggests that an increase in diversification

by 1 point – spanning a fifth of the scale observed across countries from 1 to 6 – would in the average country go along with an increase in per capita GNI by 57%.

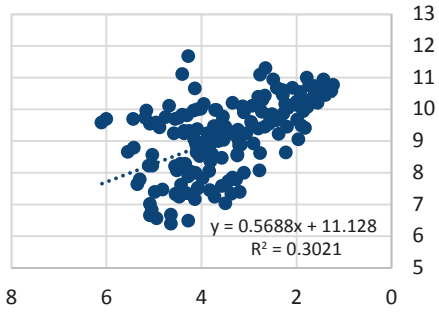
Bivariate correlations such as those shown in Figure 2a do not allow us to make any valid inferences about cause and effect. While theory suggests that economic diversification can be good for growth, economic growth is probably also conducive to diversification. However, Figure 2a does not seem to support the hypothesis of a U-shaped relationship reported in several studies to suggest that diversification, while prevalent in many low-income countries, tends to slow down or reverse course at higher levels of income as new opportunities for specialisation arise. But whether economic diversification and growth tend to go hand-in-hand only up to a certain mid-range level of per capita GNI or whether the relationship persists at high levels of income, available empirical evidence – including Figure 2a – serves as a warning against excessive specialisation, especially in early stages of economic development.

Next, we look at the IMF´s Product Quality Index introduced in Figure 1b. In Figure 2b, we see a highly significant correlation between the average value of the PQI during 1962-2010 and the latest available level of per capita GNI. Per capita incomes and product quality go hand-in-hand from bottom-left to top-right in the figure. Specifically, when the PQI increases by 0.1 – an increase that spans one sixth of the range of the variable from 0.5 to 1.1 – per capita GNI rises by 53%, a figure that is similar to that deduced from Figure 2a. The causation, if that is what the pattern suggests, must run from product quality to growth because per capita GNI in 2014 cannot possibly have had a retroactive influence on the PQI. The same remark applies to Figures 2a and 2c.

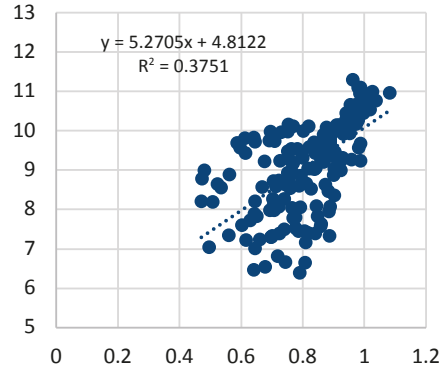
Finally, Figure 2c shows the cross-country relationship between per capita GNI and the Economic Complexity Index (ECI) introduced in Figure 1c. Once more, we see a significantly positive relationship, suggesting that a 20-point increase in complexity from one country to another – spanning a fifth of the scale from 0 to 100 – goes along with an increase in per capita GNI by 58%, again a similar result to before.

Figure 2 Economic diversification and growth

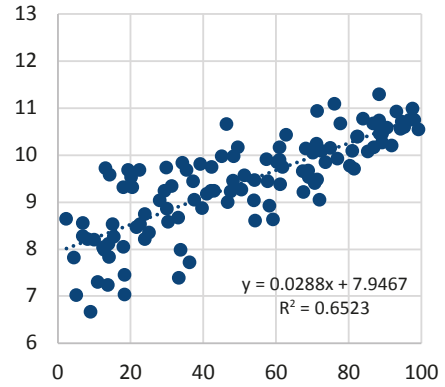
a. Economic diversification: 164 countries



b. Product quality: 168 countries



c. Economic complexity: 116 countries



Source: Author´s computations based on data from World Bank, World Development Indicators, and IMF (Panels A and B) and Atlas of Economic Complexity (Panel C). Note: Log of per capita GNI on vertical axes. Rising curves mean more diversification. Panel A: Theil index of diversification on horizontal axis; Panel B: Product Quality Index on horizontal axis; Panel C: Economic complexity on horizontal axis, defined as 100*(1 – rank/124) where 124 is the number of countries included in the ECI ranking. The six GCC countries are excluded from all three panels.

All in all, the cross-sectional correlations presented in Figure 2 suggest a clear cross-country connection between economic growth and economic diversification, product quality, and complexity. If so, economic diversification is not only desirable in its own right, but also because it may be an independent catalyst for economic growth. Digging deeper into the data by panel estimation methods to see if the significance of the cross-sectional patterns reported here is preserved within as well as across countries – i.e. across time as well as space – must await further work. Perhaps such an undertaking ought to await the anticipated availability of disaggregated trade data covering services as well as products. It would also be of interest to see if indices of geographic diversification of trade are correlated with economic growth across countries, which is not a foregone conclusion in view of the insights and empirical results from gravity models that suggest that countries generally prefer to trade with their neighbours than to trade with more distant countries.

Conclusions

The desire for economic diversification can be justified, *inter alia*, on the grounds of the observed cross-country relationship between different measures of economic diversification and macroeconomic performance. This relationship suggests that diversification is good for long-run growth. One possible way to interpret the cross-country evidence is to view economic diversification as an essential element of rapid and sustainable economic growth. Before we can reach that conclusion, however, the data on economic diversification need to be extended from the present focus on goods alone to include goods and services, work that is underway at the IMF. In principle, the diversification of services should reduce exposure to macroeconomic risk in the same way as the diversification of goods for export.

The foremost policy measures needed to manage natural resources efficiently and fairly and to mitigate climate change – notably, the regulation of emissions by price rather than by quantity by levying fees on emissions rather than imposing quotas – are intimately related to those measures that can be most effectively used as instruments of economic diversification. This is because climate change and excessive specialisation in especially natural resource-based production share a common characteristic – as a rule, natural resource wealth and the earth's climate are common-property resources

that need to be viewed and managed as such. Oil and other mineral reserves, fish stocks, and so on are limited resources, and so is our common climate. Chemical pollution from burning oil and coal, overexploitation that threatens valuable fish species, and climate change are comparable forms of environmental degradation, all of which call for efficient and fair conservation by price.

Efficiency and fairness require levying user fees on those who want to drill for oil, burn coal, catch fish, and emit carbon and other gases into the atmosphere – fees that should take the form of selling preferably transferable utilisation licenses to users. This follows from the 'polluter pays' principle first recommended by the OECD in 1972 and subsequently included in the EU's first Environmental Action Program 1973-1976 and, since 1987, enshrined in the Treaty of the European Communities as well as in the laws of many countries around the world.

The revenue from such fees needs to accrue to the right owner of the resources in question – that is, where appropriate, to the state on behalf of the people – and can be used to finance further conservation of the environment as well as to reduce taxes or increase public spending.

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11 Diversifying the Middle East and Africa

Jean Imbs
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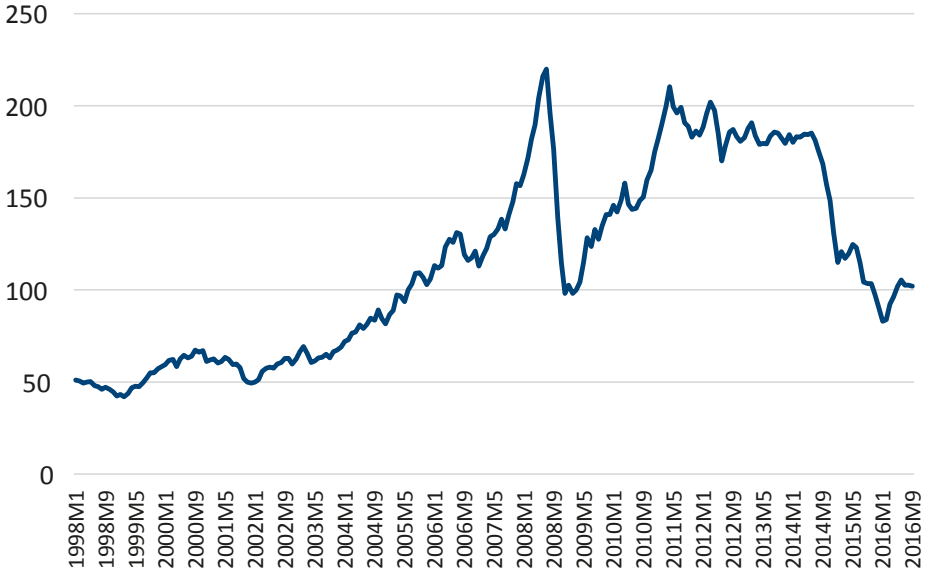
Developing countries are notoriously more specialised than advanced economies. Over the course of development, poor countries diversify as the allocation of factors of production becomes increasingly uniform across sectors (Imbs and Wacziarg 2003, Koren and Tenreyro 2007). The starting point is typically an economy specialised in primary goods or extractive activities. With industrialisation, a manufacturing sector emerges first, followed by others as manufacturing itself diversifies and factors are allocated more equally across industries. This chronology seems to characterise the economic miracles of the 20th and 21st centuries (Germany, Japan, Korea, China, to name a few), but also the earlier Industrial Revolution started in continental Europe. Evidently, a forensic analysis of the mechanics of diversification is a first-order research question, with far-ranging policy implications.

Between 2000 and 2014, emerging markets experienced unprecedentedly high growth in per capita GDP, above 4% on average. China, with growth above 9% combined with its sheer economic size, played a large part in this exceptional performance. But the period was also characterised by relatively homogeneous and universally high growth in the emerging world, especially in Africa. The episode correlates highly with an index of commodity prices, with a boom from the mid-2000, a short-lived drop around the Great Recession of 2007, and a sustained historical high from 2010 to 2014. Since 2014, however, growth in emerging markets and commodity prices have both experienced large and simultaneous decreases (Figure 1). Given the extreme specialisation of a lot of emerging markets, especially in Africa, it is apparent that emerging market growth is increasingly dependent on commodity prices. A lot of these countries are growing, but not diversifying. This is important for the prospects of economic growth in Africa,

in the emerging world, and indeed globally. But it is also important for the resilience of the world economy, as specialised economies are inherently more volatile.

Figure 1 Commodity prices



The African case is particularly worrisome. Table 1 reports the estimates for a regression of the degree of economic specialisation (measured by a Herfindahl index of sector shares) on income per capita. The first column illustrates the well-known fact that rich countries tend to be less specialised; the second column shows the case of Africa, based on observations from Egypt, Ghana, Guinea, Kenya, Mali, Rwanda, Senegal, South Africa, Tanzania, and Uganda. Specification (ii) clearly indicates that African countries are more specialised than would be predicted by their income per capita. This survives, in column (iii), the inclusion of a quadratic term controlling for potential non-linearities in this relation. Column (iv) compares Africa with other regions – Latin America (Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Ecuador, Mexico, Panama, Peru, Saint Lucia, and Venezuela) is in fact *less* specialised than would be predicted by its level of per capita income. Africa continues to be abnormally specialised in a cross-country sense. Finally, the last two columns of the table reproduce the estimation when the index of specialisation is computed omitting the mining sector, reasoning that it constitutes a large part of commodity-exporting economies in Africa.

None of the results is affected, suggesting the specialisation of Africa is a problem that is more general than just the preponderance of extractive activities that the continent has featured over the past 15 years.[1]

Table 1 Specialisation and economic development

	(i)	(ii)	(iii)	(iv)	(v)	(vi)
Per capita GDP	-0.601*** (0.138)	-0.501*** (0.129)	-2.880*** (0.395)	-2.875*** (0.409)	-2.921*** (0.395)	-2.881*** (0.406)
(Per capita GDP)^2			6.835*** (1.091)	5.821*** (0.979)	6.917*** (1.095)	5.853*** (0.972)
Africa		0.197*** (0.047)	0.149*** (0.041)	0.096*** (0.043)	0.151*** (0.041)	0.098*** (0.036)
Latin America				-0.106*** (0.023)		-0.109*** (0.023)
OECD				0.025 (0.046)		0.021 (0.046)
Obs.	122	122	122	122	122	122

Notes: The dependent variable is a Herfindahl index of employment shares, computed at the one-digit level from decennial census data collected by Integrated Public Use Microdata Series (IPUMS). All estimations include a year effect. Estimates in the first row are multiplied by 10^5, those in the second row are multiplied by 10^{10}. T-statistics are reported between parentheses; *** denotes significance at the 1% confidence level.

Why are African countries so stubbornly specialised? And why is this pattern surviving long periods of persistently high export prices, which could readily be used to finance diversification? The question has many answers, coming from many literatures. A famous one has become known as the Dutch disease, which catches as factors of production get reallocated to the exploitation of natural resources at the expense of manufacturing traded sectors. The relative price of non-traded goods increases, which worsens the competitive position of exports other than natural resources and exacerbates the vicious circle. The Dutch disease is obviously at play in many developing economies, especially in Africa (Van Der Ploeg 2016). Still, it is interesting to note that the results in Table 1 hold even if mining activities are excluded from the analysis – Africa is abnormally specialised even if one ignores natural resources. A non-competing explanation builds

1 The IPUMS data ranges from 1962 to 2007. Since the data are based on census, they are decennial, and how recent they are depends on when censuses were conducted (for instance, Ghana did so in 2000, Tanzania did so in 2002, but Senegal did so in 1988). The median year is 1998 for Africa.

from the political economy. A ruling elite appropriates most of the rents associated with resources extraction and has an interest in preserving the status quo of a specialised economy. Institutions are key in perpetuating this state of affairs, featuring high rates of inequalities and little counter-powers to the elite.

Finally, the globalisation of world trade is often accused of having perpetuated and perhaps exacerbated the specialisation of Africa. With China's rising interest in imported commodities, the incentives for investing elsewhere than in extractive activities are minimal. And commodity exports (and therefore specialisation) are facilitated by the emergence of an infrastructure that is dedicated to international trade: deep water harbours, roads from the site where extraction takes place, or foreign skills and technology used in actual extraction techniques. However, this explanation has a hard time explaining why the non-extractive sectors of African economies continue to be abnormally specialised.

Here I offer an explanation, based not on integration with international markets, but on integration with local markets. The idea is that the emergence of a manufacturing sector is heavily hampered in Africa due to the absence of local market access. In the presence of increasing returns to scale, for instance because of fixed costs of production, reduced market size implies the costs of opening new activities exceed their benefits (Acemoglu and Zilibotti 1997). So specialization in primary, agricultural sectors persists over time, as entrepreneurs do not find it worth their while to open up new sectors. International trade does not help, since it mostly creates incentives to serve the international market, which for Africa means commodity exports.

From an empirical standpoint, this argument implies that African economies should be constituted of regions that are themselves extremely specialised, and that potentially tend to produce homogeneously in similar, presumably primary sectors. Both are symptoms of the difficulty for new, manufacturing sectors to emerge. I now investigate both possibilities. First, Table 2 presents the average regional specialisation, measured as in Table 1 with a Herfindahl index of employment shares. The data are once again collected from IPUMS, but now at the regional (sub-national) level. Table 2 replicates the specifications presented in Table 1, with one change only – instead of country-level measures of specialization, Table 2 reports Herfindahl indices of employment shares, computed at the regional level and averaged up to the aggregate level using regions

weights. The results are virtually unchanged – as with country level indices, Africa's regions are also found to be abnormally specialised. Specifications (v) and (vi) suggest this is not an artefact of economies that are specialised in mining activities.

Table 2 Regional specialisation and economic development

	(i)	(ii)	(iii)	(iv)	(v)	(vi)
Per capita GDP	-0.757*** (0.143)	-0.656*** (0.134)	-3.140*** (0.410)	-3.200*** (0.427)	-3.187*** (0.409)	-3.230*** (0.423)
(Per capita GDP)^2			7.141*** (1.135)	6.172*** (1.020)	7.230*** (1.131)	6.231*** (1.011)
Africa		0.201*** (0.049)	0.151*** (0.042)	0.097** (0.043)	0.152*** (0.042)	0.097** (0.037)
Latin America				-0.104*** (0.023)		-0.107*** (0.024)
OECD				0.040 (0.048)		0.038 (0.048)
Obs.	122	122	122	122	122	122

Notes: The dependent variable is a Herfindahl index of employment shares, computed at the regional, one-digit level from decennial census data collected by Integrated Public Use Microdata Series (IPUMS). All estimations include a year effect. Estimates in the first row are multiplied by 10^5, those in the second row are multiplied by 10^{10}. T-statistics are reported between parentheses; *** (**) denotes significance at the 1% (5%) confidence level.

African countries are therefore specialised because their constituent regions are themselves quite specialised – and this not only in extractive activities. The similarity of results in Tables 1 and 2 suggests regional specialisation correlates strongly with aggregate specialisation. But is there a residual effect, corresponding to these constituent regions being specialised in similar activities? If they were, this would of course reinforce aggregate specialisation. A simple way to establish whether that is the case is to compute the difference between country-level specialisation (from Table 1) and the average specialisation of its constituent regions (from Table 2). Then the residual will be the part of aggregate specialisation that is not explained by average regional specialisation.

In Table 3, I investigate how this residual measure correlates with per capita income, and whether Africa constitutes once again an exception. Interestingly, the residual correlates positively with per capita GDP, an indication that the specialisation between regions is increasingly relevant as incomes rise. But as shown in specifications (ii) to (vi), there is no African exception, as the coefficients on the African variable are never significant. As a matter of fact, no region of the world appears to be special in terms of the gap between aggregate and regional specialisation. Income per capita appears to be a sufficient statistic. This continues to be true in specifications (v) and (vi) where, once again, mining activities are omitted from the computations of specialisation index. Put differently, the special African case documented in Table 1 (and 2) does not come from any specific pattern of production across regions. African countries are very specialised because they are constituted of very specialised regions.

Table 3 Specialisation between regions and economic development

	(i)	(ii)	(iii)	(iv)	(v)	(vi)
Per capita GDP	0.156*** (0.024)	0.154*** (0.026)	0.260*** (0.093)	0.334*** (0.112)	0.266*** (0.093)	0.346*** (0.112)
(Per capita GDP)^2			-0.304 (0.256)	-0.353 (0.268)	-0.317 (0.258)	-0.372 (0.269)
Africa		-0.004 (0.009)	-0.002 (0.009)	-0.000 (0.009)	-0.001 (0.009)	0.000 (0.009)
Latin America				-0.002 (0.006)		-0.003 (0.006)
OECD				-0.015 (0.013)		-0.017 (0.013)
Obs.	122	122	122	122	122	122

Notes: The dependent variable is the difference between the aggregate measure of specialisation from Table 1, and the average regional measure from Table 2. All estimations include a year effect. Estimates in the first row are multiplied by 10^5, those in the second row are multiplied by 10^{10}. T-statistics are reported between parentheses; *** (**) denotes significance at the 1% (5%) confidence level.

A related implication of an explanation based on limited market access is the notion that African regions tend to be stuck in primary or agricultural sectors, as a juxtaposition of largely autarkic economic entities that barely trade with each other. A final interesting question is therefore whether omitting primary activities (like agriculture, hunting or fishing) changes anything to the African exception. Table 4 performs this exercise, and duplicates the last specifications of Tables 1, 2, and 3, but with measures of specialisation

that are computed omitting the primary sector (agriculture, hunting, etc.). Column (i) suggests the primary sector is of great importance to the African case – abstracting from these activities, there is no sense that Africa is especially specialised. At the same time, column (i) continues to imply that poor countries are particularly specialised, with a (now weakly significant) relationship between aggregate specialisation and per capita GDP. Interestingly, Latin America is particularly diversified for its levels of income per capita.

Column (ii) investigates whether average regional specialisation is still abnormally high in Africa abstracting from agriculture. The answer is no – African regions are actually somewhat diversified for poor regions. The key problem that explains why they are specialised is therefore clearly the enormous and persistent size of the primary sector. The third column confirms this finding – African regions do not appear to produce in similar sectors other than primary ones. Historically, therefore, the African disease is not one of expanding mining and extractive activities, but rather one of persistently large agricultural activities, at both the national and regional level.

Table 4 Omitting primary sectors

	(i)	(ii)	(iii)
Per capita GDP	-0.097* (0.052)	-0.113* (0.060)	-0.015 (0.017)
Africa	0.015 (0.010)	-0.021* (0.011)	-0.006* (0.003)
Latin America	-0.023*** (0.006)	-0.027*** (0.007)	0.004** (0.002)
OECD	0.007 (0.013)	0.004 (0.015)	0.003 (0.004)
Obs.	122	122	122

Notes: The dependent variable in column (i) is the overall aggregate specialization from Table 1, in column (ii) it is the average regional specialisation measure from Table 2, and in column (iii) it is the difference between the two from Table 3. All estimations include a year effect. Estimates in the first row are multiplied by 105, those in the second row are multiplied by 1010. T-statistics are reported between parentheses; *** (**, *) denotes significance at the 1% (5%, 10%) confidence level.

What do these results imply for policy? First, the lack of diversification in African countries is a regional phenomenon, and one that, perhaps surprisingly, is not historically driven by extractive activities based on natural resources. African economies are abnormally specialised, including at the regional level, but not in mining or other resource-driven sectors. In fact, the main culprit of African extreme specialisation appears to be the persistent prevalence of large primary sectors, systematically at the regional level. Why are African countries also often a juxtaposition of agricultural regions? A supply-based answer is that productivity in these sectors is growing sluggishly, and so does not free factors of production – especially labour – that can then contribute to the emergence of manufactures. A demand-based explanation is that local market access is severely limited, which compounds (or perhaps explains) the low productivity problem. Establishing which of these explanations dominates should be the top priority for anyone interested in industrial policy in developing economies, especially in Africa.

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Global commodity markets have been in upheaval in recent decades. After years of high prices, a new era of lower ones, especially for oil, seems likely to persist. This will be challenging for resource-rich developing economies, which must cope with the decline in income that accompanies the lower prices and the potential widening of internal and external imbalances. The market for petroleum, the most important of the commodities, has been roiled by innovative recovery techniques that not only sharply increased oil production but have also made that production so resilient to price declines that oil price cycles almost assuredly will be shorter and more limited on the upside.

Leading economists from academia and the public and private sectors gathered in Algiers in May 2016 to examine this shifting landscape in commodity markets, particularly for oil, where global supply is not the only risk factor. Demand too is likely to be curtailed by both a slowdown in growth in developing economies and global efforts to reduce carbon emissions. In the contributions to this eBook, the economists assess the exchange rate, monetary and fiscal options available to policymakers seeking to make their economies less susceptible to the vagaries of commodity markets. But if resource-rich economies are to thrive in the long run, they must undertake structural transformation to make themselves decidedly less dependent on resources. To that end, the economists explore how finance and sovereign wealth funds can support the transition from a resource-dependent economy to one with a diverse set of productive sectors.

The common denominator of the research is that the countries must build and maintain a robust macroeconomic framework in the wake of the collapse in commodity prices while transforming their economies.

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