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Absorptive capacity and the impact of commodity terms of trade shocks in resource export-dependent economies

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ABSORPTIVE CAPACITY AND THE IMPACT OF COMMODITY TERMS OF TRADE SHOCKS IN RESOURCE EXPORTDEPENDENT ECONOMIES

Akiko Terada-Hagiwara, Mai Lin C. Villaruel, and Christopher Edmonds

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The analysis presented in this paper draws from research originally prepared for the Asian Development Outlook 2014 and the Pacific Economic Monitor 2014.





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ABSTRACT

This paper investigates the role of "absorptive capacity" to manage unexpected shocks to their real economy, with a focus on small, open, natural resource-dependent economies. A quarterly panel data series for 45 countries is constructed, including 23 developing Asian countries for empirical investigation. For the entire sample, the analysis finds that absorptive capacity, choice of exchange rate regime, presence of wealth funds, level of foreign reserves, or degree of resource dependency alone, does not matter when real shocks are introduced to output. However, levels of absorptive capacity or ability to use resource windfalls effectively, and foreign reserves begin to matter when the sample is restricted to resource-dependent countries. Case studies from Papua New Guinea and Timor-Leste support this claim highlighting the challenges they face with a sudden influx of natural resource revenues when capacity to effectively use fiscal revenues is limited.

Keywords: absorptive capacity, economic growth, natural resources, real exchange rate, terms of trade

JEL codes: F14, F43, H11

I. INTRODUCTION AND LITERATURE REVIEW

Management of natural resource windfalls is pivotal to the short- to medium-run challenge for policy makers in resource-rich countries. The drastic changes in commodity prices before and after the global financial and economic crisis (2007 and 2009) and, more recently, with the low commodity prices that have prevailed since mid-2014, have highlighted, again, the importance and peculiarity of price movements. Since the resource windfalls tend to be large relative to the size of many small, open economies, they can generate macroeconomic pressures, mainly through fiscal policy. As fiscal policy is the main impulse through which windfalls influence economic activity, this paper relates to a series of studies on aid windfalls for the interaction of fiscal and reserve policy during aid inflows (Berg et al. 2010). In this line of studies, absorptive capacity of the government is the key to determine the magnitude of the impacts, which is the focus of this paper.

Methodologically, this paper relates to Broda (2004) in investigating impacts of terms of trade (TOT) shocks on real factors, but differs in several aspects. First, it investigates the transmission of the shocks through commodity prices rather than export and import price movements, in general. This is because the commodity prices tend to be much more volatile than prices of manufacturing products, and commodities are particularly significant for many small, open economies. Since many of the commodity exporters in Asia are small, open economies, they can suffer from detrimental impacts from abrupt movements. Secondly, attention is paid to various factors that affect the degree of impacts arising from commodity price fluctuations.

In addition to the exchange rate regime considered by Broda (2004), we look closely at other factors relevant to natural resource exporters in developing countries, such as the presence of wealth funds, level of foreign exchange reserves, and absorptive capacity. Studies such as Mendoza (1995), Barro (1996), and Kose (2002) also show that the TOT shocks explain a significant portion of the actual gross domestic product (GDP) variability, and it is particularly so in developing countries (Bems and Filho 2011). Similar findings in terms of impacts are in order for real effective exchange rates (REER). Aizenman et al. (2012) claim that relative price fluctuation of exports and imports is a major determinant of real exchange rate volatility. Further, they find that international reserves cushion the impact of TOT shocks and the REER is cushioned by international reserves for developing countries but not for industrialized countries (e.g., Aizenman and Riera-Crichton 2008). Not only international reserves can buffer and stabilize the impact of real shocks but also flexible exchange rate arrangements help reduce the impact both in emerging and industrial economies (Edwards and Yeyati 2005).

The objective of the paper is to examine the impacts of shocks in prices, particularly sharp on changes in non-oil commodity terms of trade (CTOT) on the macroeconomic performance of a number of small, open economies in Asia and the Pacific. Contributions of this paper are several folds. First, this paper sheds light on underinvestigated small economies in Asia and the Pacific region mainly due to lack of data especially in the Pacific island economies. We use quarterly data series on CTOT, output, REER, and real interest rates for 45 countries, including 23 countries in Asia and the Pacific. Using these data we analyze the relationship between the macroeconomic variables and consider how they influence the relationship between external shocks and economic growth in small, open, and natural resource-dependent economies. Second, this paper focuses and examines the role of institutions or the absorptive capacity of a country, in particular, as a factor amplifying in determining

Papers suggest that there are direct links between TOT shocks and the REER: Dornbusch 1983, Marion 1984, Ostry 1988, Edwards 1989, and Frenkel and Razin 1992.

the impact of the shocks. Unlike widely examined factors, such as exchange rate regime or precautionary buffers, the absorptive capacity or the ability to use the natural resource windfalls has been overlooked in the formal analysis. We use composite index of absorptive capacity that measures absorptive capacities at a country level to see if this factor matters in transmitting the price shocks to real sectors. Finally, this paper provides case studies from Papua New Guinea and Timor-Leste to complement the empirical findings.

The paper finds that commodity price shocks per se do not matter on real output, on the average, regardless of whether a country is natural resource dependent or not. Furthermore, our analysis suggests that the choice of exchange rate regime, presence of wealth funds, level of foreign reserves nor degree of resource and dependency alone, does not aggravate the impacts arising from the external shocks on either output or REER. The major finding of this paper is that the levels of absorptive capacity and foreign reserves begin to matter when the sample is restricted to resourcedependent countries.

The remainder of this paper is organized as follows. Section II discusses the data used in the paper's empirical analysis. Section III discusses the empirical approach. Case studies are considered in section IV and the final section offers some conclusions.

DATA SOURCES AND CONSTRUCTION II.

As booms in commodity prices do not necessarily translate directly into TOT, we construct a more appropriate measure to capture commodity price fluctuations in this paper, CTOT, defined as the ratio of weighted real commodity export prices to weighted real commodity import prices, which reflects changes in commodity prices but also the importance of commodities to the overall economy.²

CTOT is computed for country i at time t, as follows:

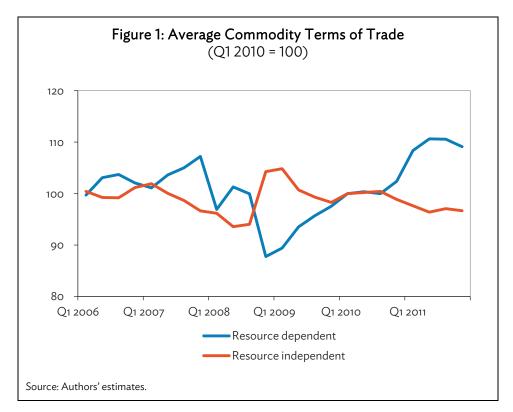
$$CTOT_{jt} = \prod_{i} (P_{it}/MUV_t)^{X_{ij}} / \prod_{i} (P_{it}/MUV_t)^{M_{ij}}$$

where P_{it} are the individual commodity prices, MUV_t is a manufacturing unit value index used as deflators, X_{ij} is the share of exports of commodity i in a country j's GDP_t , and M_{ij} is the share of imports of commodity i in a country j's GDP_t . The weights are defined in terms of GDP; hence, they take into account cross-country differences in both the composition of commodity exports and import baskets, and the importance of commodities to the overall economy.

Figure 1 shows the computed CTOT of both resource-dependent and resource-independent country groups. A country is considered natural resource dependent if the share of merchandise exports to nominal GDP account for more than 20% share, the country is resource independent otherwise. The CTOT of the natural resource-dependent economies has been guite volatile, on the average in recent years. It improved sharply by 5% in 2007, deteriorated by more than 10% toward the end of 2008, and then surged by 6.6% by the end of 2011. On the other hand, the CTOT has been

The same methodology used by Deaton and Miller (1996); and Cashin, Cespedes, and Sahay (2004); and Spatafora and Tytell (2009).

relatively stable for countries with more diversified export products—deteriorating somewhat throughout 2008 before picking up in early 2009.



In addition to the CTOT, empirical analysis includes quarterly data for the following variables: the cyclical component of real GDP, the REER, and the real interest rate.³ A real GDP proxy was computed following Litterman (1983).4 Cyclical components of real GDP is constructed using the X12 ARIMA to remove its seasonality component and use Hodrick-Prescott filtered trend to separate the cyclical component of the time series before standardization. Published country data on REERs are used, and augmented with data from Terada-Hagiwara and Villaruel (2013). The real interest rate is calculated as the 6-month United States dollar London Interbank Offered Rate, deflated using the United States inflation rate. The four constructed variables are standardized to have a standard deviation of 1 for comparability across countries, and are log transformed (except for the real interest rate).

Criteria for Dividing Sample Countries

The panel dataset extends from the first quarter of 2006 to the fourth quarter of 2011, and covers 45 countries, including 23 from developing Asia and the Pacific. The countries were categorized according to their degree of resource dependency, absorptive capacity, existence of wealth funds, level of foreign reserves, and the exchange rate regime. The four-variable system is estimated separately for country groups under the categories mentioned above (Appendix 1).

Unpublished data computed by ADB staff.

Detailed discussion of the construction of the GDP proxy is available from the authors upon request.

The degree of resource dependency is determined using the share of the value of merchandise export to nominal GDP. The country is considered as natural resource dependent if the share of the value of merchandise export to nominal GDP is higher than 20% else, natural resource independent. For the level of absorptive capacity of the developing countries, countries are divided using the median value (0.45) of developing countries considered. Countries are categorized whether they have sovereign wealth funds.⁵ The exchange rate regime classification use the dataset from Ilzetzki, Reinhart, and Rogoff (2011). Countries are categorized to have high foreign exchange reserves if the share of foreign reserves to GDP is greater than the median value of 19%.

To capture the absorptive capacity, an aid effectiveness indicator has been used. Feeny and de Silva (2012) developed a composite index of absorptive capacity which includes three major components: capital (human capital and infrastructure), governance (policy/institutional), and donor (donor practices). The index is designed to measure the capability of effectively using development funds and to provide donors with criteria for allocating their annual aid budgets. Existing literature claims that limited absorptive capacity impedes the effectiveness of foreign aid and needs to be systematically considered by donors when allocating aid.

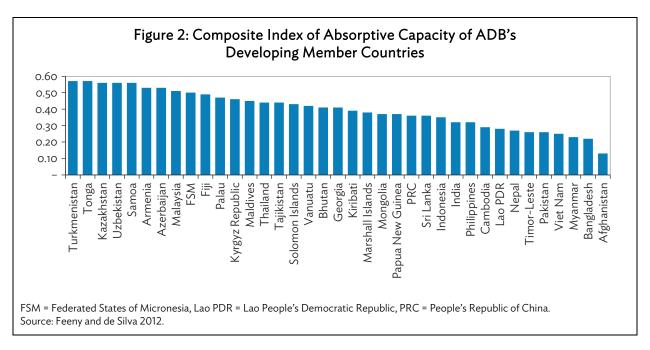


Figure 2 shows that a number of developing countries with low levels of absorptive capacity. The average index of the 37 developing Asian economies included in the ranking is on a par with the rest of the developing world. However, among the countries in developing Asia and the Pacific, Afghanistan, Bangladesh, Myanmar, Viet Nam, Pakistan, Timor-Leste, Nepal, and the Lao People's Democratic Republic scored below the median of all developing countries in the sample, suggesting relatively low absorptive capacity.

⁵ Based on information from Sovereign Wealth Fund Institute. http://www.swfinstitute.org/sovereign-wealth-fund-rankings/ (accessed 15 February 2014).

⁶ The choice of component is based on the findings of the aid effectiveness literature concerning their importance, as there is a very broad consensus throughout the literature that each of the components chosen can hamper the use of additional aid.

EMPIRICAL ANALYSIS AND RESULTS III.

Α. Estimation Model

In order to examine the empirical behavior of real GDP (y) and real effective exchange rates (r) when commodity terms of trade (tt) and real interest rate (I) shocks are introduced, we use panel vector autoregressive (VAR) analysis. The panel VAR is used to forecast systems of interrelated time series and to analyze the dynamic impact of random disturbances on the system of variables as well as the interdependencies and unobserved individual heterogeneity. A panel VAR is specified as follows.

$$A_0 Y_{it} = A(L) Y_{it} + B(L) X_{it} + u_{it}$$

where $Y'_{it} = (y_{it}, r_{it}, I_{it}, tt_{it})$, vectors of endogenous variables, are standardized to have a standard deviation of 1 for comparability across countries and are log transformed (except for the real interest rate). The first subscript $i \in \{1, ..., N\}$ refers to N countries and the $t \in \{1, ..., T\}$ refers to the time dimensions of the panel of observations $\{y_{it}\}$ $1 \leq i \leq N$ $1 \leq t \leq T$ $1 \leq t \leq T$ are white noise error term. X_{it} is a matrix of exogenous variables $(I_{it}, \overline{tt_{it}})$, A(L), and B(L) are matrix polynomials in the lag operator of order 4, and $var(u_{it}) = \Omega$. To examine the different responses to real shocks across the different classifications introduced above, A(L) and B(L) were allowed to differ.

Variance decomposition or forecast error variance decomposition (FEVD) indicates the amount of information each variable contributes to the other variables and determines how much of the FEVD of each of the variables can be explained by exogenous shocks. Thus the variance decomposition provides information about the relative importance of each random innovation in affecting the variables in the VAR model. To compare response of different economies to shocks, panel VAR were estimated separately for the following classifications: degree of resource dependency, exchange rate regime adopted, existence of wealth funds, level of foreign reserves, and absorptive capacity.

Prior to the VAR estimation, a unit root test was performed to check if the stationarity assumption is satisfied. A stationary process has the property that the mean, variance, and autocorrelation structure do not change over time. The table below reports the results of the panel unit root test. The Levin, Lin, and Chu (2002), which is a test based on a common unit root process and the Im, Pesaran, and Shin (2003) test allow for heterogeneity in the value of the autoregressive coefficients under the alternative hypothesis. The test results suggest that the four standardized series are stationary.

Panel Unit Root Tests

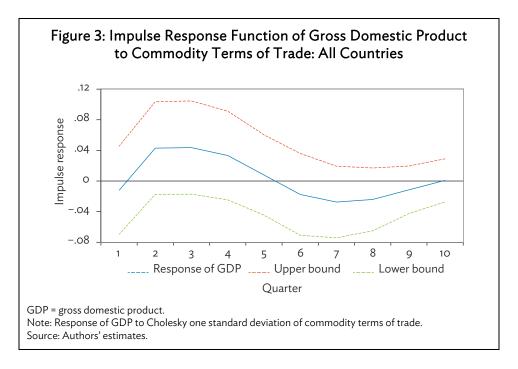
Panel Unit Root Test	GDP	REER	Real Interest Rates	СТОТ
Levin, Lin, and Chu t*	-5.41 ***	-3.62 ***	-4.68 ***	-5.20 ***
Im, Pesaran, and Shin W-stat	-9.63 ***	-3.33 ***	1.98	-5.64 ***

CTOT = commodity terms of trade, GDP = gross domestic product, REER = real effective exchange rate. Notes: Levin, Lin, and Chu Null hypothesis: Panels contain unit roots; Im, Pesaran, and Shin W-stat Null hypothesis: All panels contain unit roots; *** - significant at the 1% level; Variables are standardized. Source: Authors' estimates.

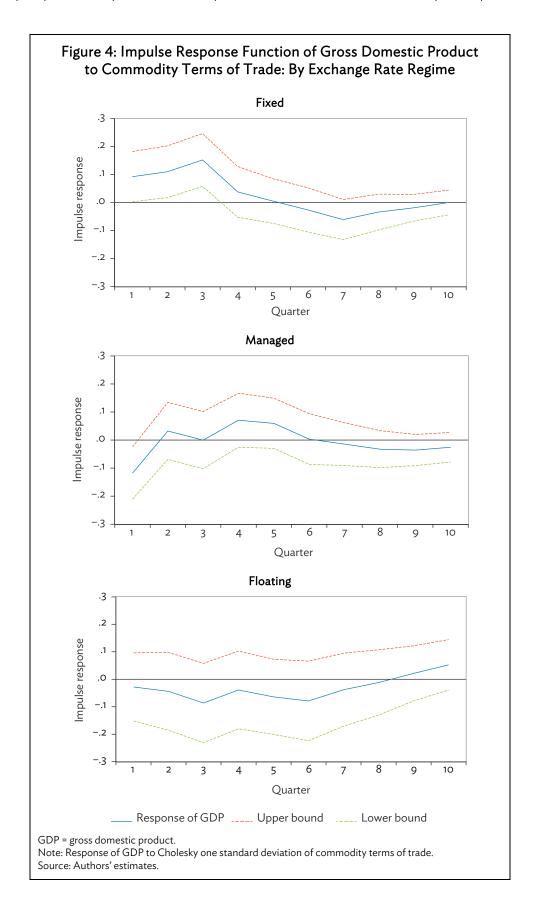
To validate the stationarity assumption, a panel cointegration test was then carried out using the Pedroni Residual Cointegration procedure. The test was based on null hypothesis with no cointegration. Out of the seven test statistics under Pedroni's test, four tests have alternative hypothesis of common AR coefficients (within-dimension) and three tests have alternative hypothesis individual AR coefficients (between-dimension). Among the test statistics, only one failed to reject the null hypothesis of no cointegration. The result shows cointegrating relationships exist. Lag order of four is used based on the Akaike information criteria (test results in Appendixes 2 and 3).

B. Estimation Results

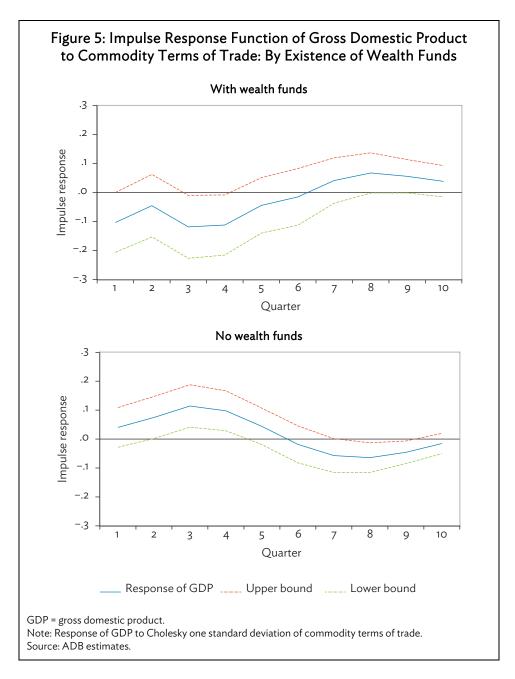
Estimation results reveal interesting and intuitive findings. In general, commodity price shocks *per se* do not seem to have a significant effect on the real output. That is to say that the countries in our sample have generally managed to insulate themselves from external commodity price shocks and to avoid real fluctuations. The variance decomposition results show that most of the variance in real output is due to the fluctuations in its own past, and less than 1% to changes in commodity prices. The impulse response functions (IRF) of the real output seem to increase in response to a positive shock in commodity prices as expected, but that is not significantly different from zero when we look at the entire sample (Figure 3). The results hold regardless of whether or not a country is dependent on natural resources.



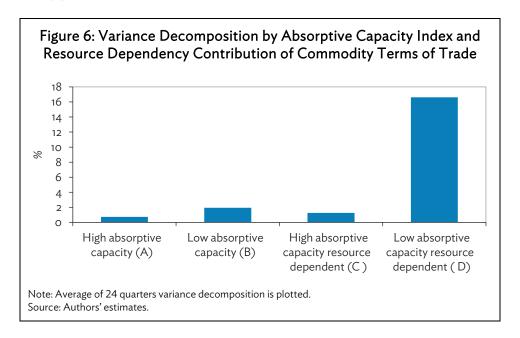
However, the results suggest that certain factors, namely fixed exchange rates and the existence of wealth funds, make real outputs significantly more volatile to commodity price shocks. The IRFs suggest that real output in countries that adopt fixed exchange rate regimes would drop in the short run as the CTOT worsens and vice versa (Figure 4). This is consistent with the findings of Broda and Tille (2003).



The role of financial buffers, either foreign exchange reserves or wealth funds, in affecting the real economy is often discussed but less examined. What we find is intuitive in that wealth funds, on average, operate to shield the real economy from price shocks by providing buffers, and countries without wealth funds tend to be severely affected by price fluctuations as shown in the IRFs falling significantly below zero in response to a deterioration in CTOT (Figure 5). The variance decomposition suggests that about 5% of the variance in real output is due to price shocks. On the other hand, the level of foreign exchange reserves or the level of absorptive capacity does not seem to matter.



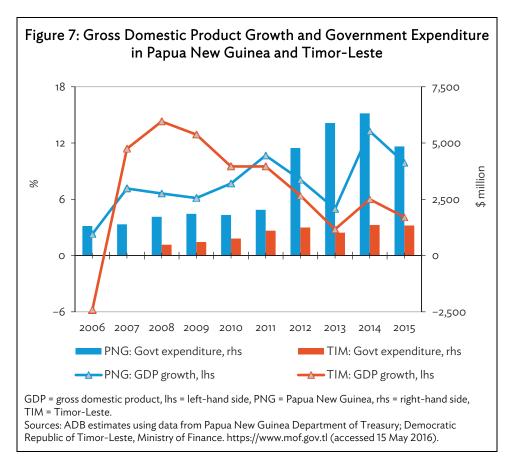
We now turn our attention to the role of absorptive capacity more closely. The estimates find that the combination of resource dependence and low absorptive capacity increases an economy's vulnerability to CTOT shocks. Looking at the full sample of countries (bars A and B in Figure 6), absorptive capacity alone does not make a significant difference, as commodity price shocks have similar output effects for high and low capacity countries. But absorptive capacity clearly matters when the sample is restricted to resource-dependent countries (bars C and D). In this case, CTOT shocks explain more than 16% of output variation, when the sample is restricted to resource-dependent economies that also display limited absorptive capacity. This explanatory power of CTOT is significantly higher than in the case of the high absorptive capacity economies. In other words, those that are less able to use windfall proceeds productively will be less able to shield real output from global commodity price shocks.



IV. CASE STUDIES: PAPUA NEW GUINEA AND TIMOR-LESTE

This section considers the cases of Papua New Guinea (PNG) and Timor-Leste, where the absorptive capacity played a major role in amplifying impacts of CTOT shocks on the real economy-mainly through fiscal policy. The role of absorptive capacity is evident in both countries, which have been among the Pacific region's fastest growing economies over the past decade—propelled by natural resource exploitation and associated foreign direct investment. Between 2002 and 2013, PNG recorded 12 consecutive years of economic growth averaging around 6% per annum, while non-oil GDP in Timor-Leste grew at an average rate of 11.0% per annum between 2007 and 2013. The rapidly expanding fiscal space generated by resource extraction activity has raised expectations in both countries that government can play a more active role in overcoming persistent development constraints through expanded public service delivery to their populations, but it also raised the issue of institutional capacity of these governments. However, the fall in global commodity prices began in 2014, growth in both economies has slowed considerably—with 2014–2015 growth in PNG averaging 8.7% and 5.6% in Timor-Leste—and both countries have faced increasingly challenging fiscal conditions.

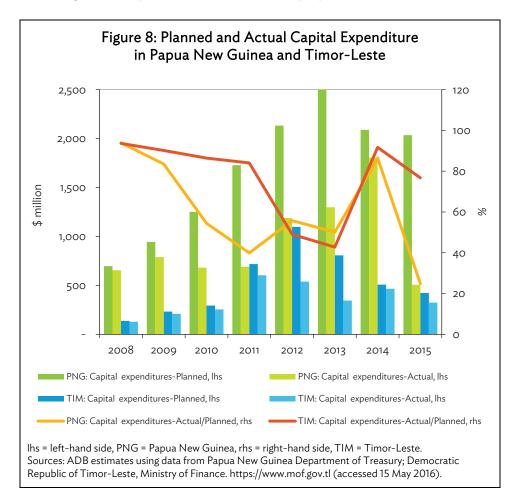
Between 2009 and 2013, total government expenditure in PNG and Timor-Leste grew at average annual rates of 12% and 19%, respectively. Both countries maintain ambitious national transport and energy infrastructure plans and are making large investments in health, education, and social services. Yet, while expanded public investment has been broadly aligned with those sectors commonly assumed to promote a more inclusive growth path, the success of this strategy has been hampered in both countries by implementation challenges. Government agencies have struggled to accomplish rapidly rising workloads and effectively translate growing budgetary resources into improved service delivery.



Weak absorptive capacity has been hindering effective implementation of the public investment in these economies. A number of factors are contributing to implementation difficulties. First, the availability of well qualified personnel to administer government infrastructure projects has been limited relative to the rapid rise in capital project implementation needs. More broadly, government agencies have also struggled to compete with salaries offered by growing private sector employers, which has hollowed out their pool of skilled technical staff with project implementation experience. Sometimes, unpredictable budgetary processes have delayed approval of plans and the availability of financial resources, leaving public agencies poorly prepared to execute projects at the beginning of each fiscal year. In PNG, this has been particularly true of the political tendency to fund infrastructure projects before detailed feasibility and preparatory design studies have been completed.

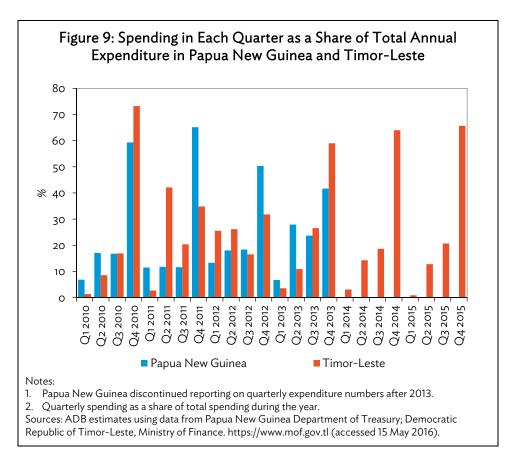
Poor execution of budget has been particularly severe in agencies tasked with delivering major infrastructure projects, which require detailed project preparation and supervision. For instance, the PNG Department of Works and Implementation, which is responsible for approximately 85% of the

government's 2014 land transport program, disbursed only 52% of its original development budget appropriation in 2013, and only 38% in 2012. In Timor-Leste, the ratio of planned to actual capital expenditure has averaged just 56.7% since 2010, as government agencies repeatedly underperform on their expenditure targets for major national infrastructure projects.



The rapid rise in public expenditures in both countries also appears to be raising challenges in obtaining value for money for disbursed funds. As can be seen in Figure 9, both countries continue to undertake a disproportionate amount of their spending in the final quarter of the fiscal year—ranging between 30%–60% of the capital budget in PNG and averaging 47.8% (30%–73% range across years) for the capital budgets in Timor-Leste.

While it is normal for disbursement rates against capital project to increase as projects progress, the extreme distribution of budget disbursements toward the end of the fiscal year signals a tendency in both countries to "push money out the door" prior to the close of fiscal accounts—in case a further appropriation during the next year's budget cycle is not forthcoming. This practice increases the likelihood of unproductive expenditure and lessens prospects that recommended public financial management accountability mechanisms will be strictly adhered to. The national electricity network development project in Timor-Leste may offer a case on point. There, the rush to use funding within the tight schedule established in national plans has been criticized as leading to both cost overruns and the development of excessive capacity.



Adding to poor value for money has also been a tendency to favor investment in new capital projects, rather than investing in the underlying institutions and agencies tasked with planning, delivering, and maintaining new assets and services. A lack of maintenance funding in particular, has contributed to an expensive "build-neglect-rebuild" cycle for many national infrastructure assets. For example, the PNG Department of Works, as a key executing agency of the government's infrastructure plans, received a 60% funding increase in 2014, on top of a 35% increase in 2013. Yet, more than 97% of this increase in funding is for additional capital projects, with limited allocations for new maintenance and operational activities. In 2014, recurrent (operational) spending will comprise just 11% of the Department's budget, down from 33% in 2011. Likewise, the ratio of personnel costs to total spending down from almost 20% in 2004 to 3% in 2014. In Timor-Leste, expenditures for staff at the main ministries that handle infrastructure development (i.e., the Ministry of Public Works and the Ministry of Transport and Communication) did not keep pace with the rising capital budgets in the late 2000s, with the ratio of staff expenditures to planned capital expenditures falling from about 5% in 2008 to just 2.5% in 2010. However, since 2010, greater resources have been allocated to staff at the ministries and this ratio has risen to about 15%.

Since global commodity prices began to fall in 2014, the PNG and Timor-Leste governments had to adjust to rapid downward adjustments in their fiscal resources, facing particular challenges in cutting multiyear expenditure increases adopted during the boom years. By late 2015, the PNG government's fiscal position had deteriorated to the point where rising debt and a rising fiscal deficit prompted sharp cuts in total expenditure and the government exploring options to float a \$1 billion sovereign bond in 2016 to refinance its borrowing. By 2015, the PNG government faced a fiscal deficit of K2.5 billion (equivalent to 4.9% of GDP) and a supplementary budget passed late in the year

identified expenditure cuts of about K1.4 billion to address the growing fiscal deficit. The 2016 budget continued the adjustment to lower revenue expectations (projecting total expenditures of K14.8 billion).

The focus on new infrastructure in PNG-instead of providing sustainable funding for operations and maintenance of existing assets—has amplified budgetary pressures, contributed to higher overall costs, and undermined the quality of service delivery. Restrictions on government spending on purchases of goods and services, and wages and salaries started in the 2013 budget are further amplifying this trend. Similarly, Timor-Leste focused on building new infrastructure, including a national electricity grid with large excess capacity that now requires a net operating subsidy that will be equivalent to approximately 7% of non-oil GDP in 2015.

Improved absorptive capacity of government authorities is the key to make fiscal policy function. In order for fiscal policy to truly promote inclusive growth, it requires more than just expanding budget allocations to priority sectors. Time and resources are needed to strengthen the underlying systems and institutions charged with executing budgetary plans and to build the human resources needed to effectively implement government programs and investments. In the cases of PNG and Timor-Leste, translating the wealth associated with natural resource extraction into inclusive fiscal policy requires a broader focus on building the capacity of the civil service, improving the coherence and coordination of the budget process, and ensuring adequate funding is provided not just for new projects but also for maintaining and operating assets once they are built.

٧. CONCLUSION

The results of the analyses suggest, broadly, that commodity price shocks per se do not have a significant impact on real output, regardless of whether a country is natural resource dependent or not. Our analysis suggests that the exchange rate regime, existence of wealth funds, level of foreign reserves and dependency alone, do not aggravate the impact of external shocks on either output or REER. A major finding of this paper is that the levels of absorptive capacity and foreign reserves begin to matter when the sample is restricted to resource-dependent countries.

Through examining data series focusing on small, open economies, this paper suggests that the combination of resource dependency and low absorptive capacity amplify impacts of CTOT shocks on natural resource-dependent economies and the vulnerability of economies to commodity price fluctuations. The level of absorptive capacity alone does not make a significant difference as commodity price shocks have similar impacts on real output for high and low absorptive capacity countries, but the level of absorptive capacity clearly matters when the shocks are restricted to resource-dependent countries. The CTOT shocks explain more than 16% of output variation if the country is resource dependent and also has limited absorptive capacity—significantly more than the high absorptive capacity group. In other words, those that are less able to use windfall proceeds productively will be less able to shield real output from global commodity price shocks. The case study from PNG and Timor-Leste supports the claim that countries with limited institutional capacity can suffer from swings in commodity prices.

Results suggest that countries with limited absorptive capacity are tested when they face uncertainties surrounding commodity price swings and depletion of natural resources, which complicate resource and macroeconomic management. Additional costs can arise whenever the speed of investment adversely impact project selection, management, and implementation as a result of the poor ability of a country to utilize capital productively—leading to reduced contributions to growth even with higher public investments. This is consistent with the fact that the fiscal multiplier tends to be smaller in low-income countries, which tend to be limited in their absorptive capacity. In summary, the analysis suggests that natural resource-dependent economies need to enhance their absorptive capacity, so windfalls from natural resources can effectively contribute to growth in a sustainable manner.

APPENDIXES

Based on Feeny and de Silva (2012), the following components were considered as factors hampering the effectiveness of foreign aid.

Appendix 1: Absorptive Capacity of Developing Countries

Component	Measurement				
Capital					
Human capital	Number of doctors per thousand people				
	Number of nurses per thousand people				
	Number of primary schools teachers per thousand people				
	Number of secondary schools teachers per thousand people				
	Adult illiteracy				
Infrastructure	Paved roads (per cent of total)				
Governance					
Policy/Institutional	Voice and accountability				
	Political instability				
	Government effectiveness				
	Regulatory quality				
	Rule of law				
	Control of corruption				
Donor					
Donor practices	Ratio of the number of DAC donors to the log of government				
	expenditures				
	Ratio of fragmentation to the log of government expenditures				

DAC = Development Assistance Committee. Source: Feeny and de Silva 2012.

Appendix 2: Data Estimation Groups

Category	Economies
Degree of Resource Dependency	
Resource independent	Argentina; Armenia; Australia; Austria; Cambodia; Canada; Denmark; Fiji; Georgia; Germany; Greece; Hong Kong, China; India; Indonesia; Japan; Latvia; Maldives; Mexico; New Zealand; Pakistan; Peru; Philippines; Poland; Samoa; Singapore; Sri Lanka; Switzerland; Sweden; Tonga; Thailand; Turkey; United Kingdom; Vanuatu; and Viet Nam
Resource dependent	Azerbaijan, Bhutan, Chile, Croatia, Hungary Kazakhstan, Kyrgyz Republic, Lithuania, Malaysia, Norway, and Solomon Islands
Absorptive Capacity	
High absorptive capacity	Argentina, Armenia, Azerbaijan, Chile, Croatia, Fiji, Kazakhstan, Kyrgyz Republic, Malaysia, Mexico, Samoa, Tonga, and Turkey
Low absorptive capacity	Bhutan, Cambodia, Georgia, India, Indonesia, Maldives, Pakistan, Peru, Philippines, Solomon Islands, Sri Lanka, Thailand, Vanuatu, and Viet Nam
Exchange Rate Regime	
Fixed	Austria, Azerbaijan, Bhutan, Hong Kong, China, Denmark, Fiji, Germany, Greece, Kazakhstan, Kyrgyz Republic, Lithuania, New Zealand, Pakistan, Sri Lanka, Sweden, Solomon Islands, Tonga, United Kingdom, and Viet Nam
Managed	Cambodia, Croatia, Georgia, India, Indonesia, Japan, Latvia, Malaysia, Maldives, Mexico, Norway, Peru, Philippines, Samoa, Thailand, Turkey, and Vanuatu
Floating	Argentina, Armenia, Australia, Canada, Chile, Hungary, Poland, Singapore, and Switzerland
Sovereign Wealth Funds	
With sovereign wealth funds	Australia; Azerbaijan; Canada; Chile; Hong Kong, China; Indonesia; Kazakhstan; Malaysia; Mexico; New Zealand; Norway; Peru; Singapore; and Viet Nam
Without sovereign wealth funds	Argentina, Armenia, Austria, Bhutan, Cambodia, Croatia, Denmark, Fiji, Georgia, Germany, Greece, Hungary, India, Japan, Kyrgyz Republic, Latvia, Lithuania, Maldives, Pakistan, Philippines, Poland, Samoa, Solomon Islands, Sri Lanka, Sweden, Switzerland, Thailand, Tonga, Turkey, United Kingdom, and Vanuatu
Foreign Reserves	
High foreign reserves	Bhutan; Cambodia; Hong Kong, China; Croatia; Denmark; Fiji; Hungary; Japan; Kyrgyz Republic; Latvia; Lithuania; Malaysia; Peru; Philippines; Poland; Samoa; Singapore; Solomon Islands; Switzerland; Thailand; Tonga; and Vanuatu
Low foreign reserves	Argentina, Armenia, Australia, Austria, Azerbaijan, Canada, Chile, Georgia, Germany, Greece, India, Indonesia, Kazakhstan, Maldives, Mexico, New Zealand, Norway, Pakistan, Sri Lanka, Sweden, Turkey, United Kingdom, and Viet Nam

Source: Authors' estimates.

Appendix 3: Pedroni Residual Cointegration Test

Series: GDP_STRD REER_STRD INT_STRD CTOT_STRD Null Hypothesis: No cointegration						
Alternative hypothesis: common AR coefficients (within-dimension)						
Weighted						
	Statistic	Prob.	Statistic	Prob.		
Panel v-Statistic	3.947337	0.0000	1.920674	0.0274		
Panel rho-Statistic	-3.843129	0.0001	-3.763945	0.0001		
Panel PP-Statistic	-11.67691	0.0000	-12.16601	0.0000		
Panel ADF-Statistic	-13.30467	0.0000	-12.86999	0.0000		

Alternative hypothesis: individual AR coefficients (between-dimension)

	Statistic	Prob.
Group rho-Statistic	-0.988677	0.1614
Group PP-Statistic	-13.08829	0.0000
Group ADF-Statistic	-13.97425	0.0000

Source: Authors' estimates.

Appendix 4: VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-4873.413	NA	0.598809	10.83869	10.86004	10.84685
1	-3141.448	3444.686	0.013219	7.025439	7.132159	7.066207
2	-3019.583	241.2909	0.010448	6.790185	6.982281	6.863567
3	-2928.033	180.4556	0.008833	6.622296	6.899768	6.728292
4	-2853.900	145.4662*	0.007763*	6.493111*	6.855958*	6.631721*

AIC = Akaike information criterion, FPE = Final prediction error, HQ = Hannan–Quinn information criterion, LR = likelihood ratio; sequential modified LR test statistic (each test at 5% level), SC = Schwarz information criterion, VAR = vector autoregressive.

Note: * indicates lag order selected by the criterion.

Source: Authors' estimates.

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Absorptive Capacity and the Impact of Commodity Terms of Trade Shocks in Resource Export-Dependent Economies

This paper investigates the role of "absorptive capacity" to manage unexpected shocks to the real economy, with a focus on small, open natural resource-dependent economies. Empirical investigation suggests that levels of absorptive capacity, or the ability to use resource windfalls effectively, and foreign reserves begin to matter when the sample is restricted to resource-dependent countries. Two case studies from Papua New Guinea and Timor-Leste support this claim, highlighting the challenges they face when confronted with a sudden influx of natural resource revenues and the capacity to effectively use fiscal revenues is limited.

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