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Managing the Impact of Resource Booms on the Real Effective Exchange Rate: The Role of Financial Sector Development

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Abstract

Whereas most of the literature related to the so-called "resource curse" tends to emphasize on institutional factors and public policies, in this research we focus on the role of the financial sector, which has been surprisingly overlooked. We find that countries that have financial systems with more depth, as well as those that actively manage their central banks' balance sheets experience less exchange-rate appreciation than countries that do not. We analyze the relationship between these two findings and suggest that they appear to follow separate mechanisms.

JEL Classification Numbers: Q33, F31, F32, O16

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I. INTRODUCTION

The "resource curse" is among the most widely studied challenges in macroeconomics, yet the phenomenon continues to thwart the aspirations of resource-rich developing countries around the world. The rapid appreciation of the real effective exchange rate (REER) reflecting a resource rich country's high-value commodity exports, has been observed to distort domestic prices and to erode the external competitiveness of firms in the non-resource sectors. Extractive industries also absorb scarce financial and human capital, raising operating costs for non-resource firms, further diminishing their ability to compete against foreign firms. Sharp increases in public spending often accompanying resource discoveries have been seen to exacerbate these effects, as the speed of the fiscal expansion undermines the integrity of public institutions. As the non-resource tax base withers, the government's dependence on the resource sector increases, and when the country's resource reserves are inevitably exhausted, it faces the grim prospect of a simultaneous fiscal and economic crisis. Even if the worst outcomes are averted, formerly resource-rich countries may struggle for years to overcome the legacy of macroeconomic distortions left by the resource curse.

For decades, macroeconomists have worked to formulate a set of policies that would enable resource-rich countries to leverage their natural capital to support long-term economic growth and sustainable poverty reduction. These efforts have yielded critical insights into the role of fiscal and monetary policy, as well as institutional quality, in shaping the development outcomes of resource-rich countries.[2] Overall, economic literature has found that countries with relatively sophisticated policy capabilities and robust institutional frameworks tend to be better able to leverage natural resources to sustainably increase economic growth. However, countries with limited policy capabilities and weak institutions are especially vulnerable to the worst effects of the resource curse. As a result, the natural resource discoveries have accelerated the socioeconomic convergence of some developing countries while deepening the poverty and political-economic dysfunction of others. However, these outcomes are not predetermined, and the mix of policies embraced by a newly resource-rich country can dramatically alter the economic impact of its resource sector.

So far, relatively little emphasis has been put in analysing the role of the financial sector in mitigating the resource course. Economic literature has pointed out how financial development is beneficial, among other, for producing information ex ante about possible investments and promoting efficient capital allocations, including by exerting corporate governance after providing finance, and facilitating the trading, diversification, and management of risk. In this paper, we conjecture that beneficial effects from having a deeper financial sector allow countries to better manage the adverse effects of the resource curse, including by increasing the efficiency of financial policies.

[2] IMF, 2012; Mehelum et al., 2006; Cust, 2015 and 2017.

We investigate how deeper, more developed, financial sectors and financial policies may have contributed to mitigating the resource curse over a set of countries that experienced a resource discovery. We use a number of different indicators of financial sector development and a measure of the sterilization policies implemented by central banks. We analyze whether they may have a role in the mitigation of the resource curse, as measured by the appreciation of the REER following a resource discovery. We also investigate whether there is a direct relationship between the financial sector development and central banks' ability to implement financial policies. In general, we find that deeper financial sectors may be indeed beneficial for countries in mitigating the extent of the resource curse, as financial policies may also be, although through a different mechanism. The rest of the paper is organized as follows: Section 2 will summarize the main literature on the macroeconomic challenges posed by the resource discovery; Section 3 describes the data, empirical methodology and estimation results; and section 4 summarizes and concludes.

II. LITERATURE REVIEW

Economic literature has established a clear link between natural resource discoveries, the appreciation of the REER, and the erosion of international competitiveness in non-resource sectors. This link was first identified in the Netherlands in the 1970s and is widely known as the Dutch disease. Many subsequent empirical studies have found that global oil prices have a significant impact on real exchange rates in oil-exporting countries.[3] The observed appreciation of the exchange rate is associated with a range of adverse macroeconomic outcomes, including widening current-account deficits and rising domestic prices. Arezki et al. (2016) find that a large oil or gas discovery causes the real exchange rate to appreciate even in the presence of a current-account deficit, defying the permanent income hypothesis, which predicts that investing resource revenues in foreign financial instruments will result in a current-account surplus. Torfinn et al. (2016) find that domestic monetary expansion, driven by rising export receipts and portfolio investment, compounds the appreciation of the REER and magnifies its effect on the prices of non-tradable goods and services. Botta (2014 and 2015) further analyzes this phenomenon and finds that the increase in capital flows causes a "financial Dutch disease," which exacerbates traditional Dutch-disease effects.

Macroeconomic imbalances caused by the appreciation of the REER in resource-rich countries have been found to reduce long-term growth rates below projections preceding the resource discovery. Extractive industries directly or indirectly divert investments and labor away from other economic activities, resulting in a decline in traditional exports that is often coupled with rising prices for non-tradable goods and

[3] Koranchelian (2005) found a positive impact of the real oil price on the Algerian REER. Korhonen and Juurikkala (2009) found that the price of oil has a clear, statistically significant effect on real exchange rates in oil-producing countries in the long run, and that increases in oil prices lead to an appreciation of the real exchange rate. Such results have been robust in studies using time-series analysis over sets of resource-exporting countries (Cashin, Cspedes and Sahay 2004; Chen and Rogoff 2003). See also: Zalduendo 2006; Issa et al. 2006; Habib and Kalamova 2007; Jahan-Parvar and Mohammadi 2008; Korhonen and Juurikkala 2009; and Kuralbayeva and Stefanski 2013.

services.[4] Numerous studies have found that growth rates in resource-rich countries often fail to reach the levels projected prior to the resource discovery due to unbalanced sectoral growth patterns. However, the relationship between economic growth and resource wealth is ambivalent, as the empirical evidence is split between countries that experienced reduced or even negative growth rates, including Nigeria and Sierra Leone, and countries that leveraged their natural resources to accelerate growth, including Malaysia, Botswana, and Chile.[5]

Many studies that have attempted to explain why resources benefit some countries and not others have focused on either the role of institutions and rent-seeking or the impact of fiscal policy.[6] The evidence indicates that countries with strong political institutions at the time of the resource discovery tend to be better positioned to reap its benefits, while countries with weak institutions tend to be more susceptible to the negative effects of the Dutch disease.[7] Cust and Poelhekke (2015) and Cust (2017) find that low institutional quality aggravates the economic underperformance of resource-rich countries. Mitchell (2005) finds that resource discoveries often lead to a sharp increase in public expenditures, which puts upward pressure on domestic prices, which in turn distorts efficiency incentives. Several authors identify excessive fiscal spending as a leading cause of economic mismanagement in resource-rich countries.[8] These findings have yielded significant emphasis on fiscal policy as the primary, if not the sole, instrument for remediating the adverse effects of resource booms. For example, Brahmbhatt et al. 2010 find that implementing fiscal rules to guide the management of resource revenues can ensure the efficient use of public revenues and help smooth expenditures and reduce volatility. However, an excessive focus on fiscal policy risks obscuring the important role that monetary policy can play in leveraging the developmental potential of natural resources.

The international literature on the resource curse has generally treated monetary policy as an ancillary concern. While a large number of empirical studies focused on the effect of sterilized intervention on exchange rates in emerging economies, none of them focused specifically on the roles of financial policies in resource rich countries. A. Mehrotra (2012) investigates the success in the use of sterilization bonds by six central banks in emerging Asia and discuss the implications for monetary policy and the financial sector. Aizenman and Glick (2009) investigated the changing pattern and efficacy of sterilization within emerging market countries as they liberalize markets and integrate with the world economy. They found that the extent of sterilization of foreign reserve inflows has risen in recent years to varying degrees in Asia as well as in Latin America, consistent with greater concerns about the potential inflationary impact of reserve inflows. The IMF (2012) suggests that there might be a role for monetary policies in containing unsustainable credit expansion following capital flows associated with the resource boom but warns against excessively countering natural appreciation.

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[4] Corden 1982; and Corden and Nearly 1984.
[5] Van der Ploeg 2011; Ross 2015.
[6] Mehlum et al. 2006; Robinson et al. 2006; Cust and Poelhekke 2015; Cust and Mihalyi. 2017 and 2018.
[7] This pattern has been also investigated by others such as Bhattarharyya and Hodler (2013); Sarmidi et al. (2012); Yuxiang and Chen (2011); Allcott and Keniston (2014); Ouedraogo (2016); Mlachila and Ouedraogo (2017); and Cust and Mihalyiz (2018).
[8] Gelb and Associates 1988; Werner and Santos 2015; and Brahmbhatt et al. 2010.

This study explores how the depth of a country's financial sector affects its ability to manage the macroeconomic distortions associated with natural resources. Following the large literature on the beneficial effects of financial sector development (Demirgüç-Kunt and Levine 2008) we investigate whether financial sector development plays a role in mitigating the resource curse. Diverging from previous studies, we use the change in the REER as an indicator of the effects of resource curse in countries that have experienced a resource discovery. We expand on the analysis of the role of the financial sector to investigate the effectiveness of sterilization policies, as conducted through central banks' active balance sheet management in resource rich countries, following Aizenman and Glick (2009). Finally, we also investigate whether financial sector development may be linked to the extent off sterilization policies implemented. To this scope, beyond the broad range of standard indicators, we also analyze the effect of financial sector structure, in particular, the depth of private sector credit vis-à-vis credit to the public sector, as this has been found in literature as particularly sensitive to monetary policy interventions (Chen, Li, and Tillmann 2019) [9] and negatively associated with financial development more in general (Humer 2009, WB 2013).

III. Data and Empirical Approach

Data Sources and Definitions

This study uses publicly available data on resource discoveries constructed from the World Bank's Wealth of Nations database. [10] The dataset covers 141 countries over 20 years [11] and contains comprehensive measures of wealth, including physical capital; financial capital; natural capital; human capital; and net foreign assets (NFAs). The study focuses on gas and oil resources, but it also encompasses other forms of nonrenewable resource wealth. According to the database, the value of a country's stock of nonrenewable resources is measured by the present value of the stream of rents that may be extracted from the resource until it is exhausted. These rents are calculated using projected revenues, production costs, and the quantity of resources extracted, and the resulting estimates are expressed in constant 2010 U.S. dollars at market exchange rates and national GDP deflators.[12] Observations in the database are present at five-year intervals, which allows us to construct four periods in which to compute changes in the value of rents. We thus construct our variable of interest which identifies whether there has been a significant change in a countries' national stock of resources. We define "significant" as a change in total resources larger than 5 percent of GDP at the beginning of the period. For country i, this is calculated as follows:

$$RD_{i,2005} = 1 \text{ if } \frac{Total\ Resource_{i,2005} - Total\ Resource_{i,2000}}{RGDP_{i,2000}} * 100\% > 5\%$$

[9] They find that private firms in China are more sensitive to monetary policy changes than are SOEs.
[10] Lange, G.M., Q. Wodon, and K. Carey, editors, The Changing Wealth of Nations 2018: Building a Sustainable Future, Washington, DC: The World Bank.
[11] Unfortunately, there are gaps in the data for 1995, 2000, 2005, 2010, and 2014.
[12] Details on the calculation can be found here: https://development-data-hub-s3-public.s3.amazonaws.com/ddhfiles/94641/wealth-methodology-january-30-2018_4_0.pdf.

where $RD_{i,t}$ represents a dummy variable that is set to 1 if a major resource discovery was made over the previous period or to 0 if not.

The study uses financial-development indicators from the World Bank's 2019 FinStats database. [13] In the study we use both the number of commercial bank branches per 10,000 people and the number of bank accounts per million people as the main explanatory variable to proxi financial sector development. As data for these indicators begin in 2008, an average value for each country is calculated based on the available data. We use private-sector bank credit as a share of GDP, credit to the government and state-owned enterprises (SOEs) as a share of GDP, and credit to the private sector as a share of credit to the public sector to construct a structural indicator of financial development.

A number of World Bank and IMF's databases provide the source for macroeconomic data. The Macro Poverty Outlook (MPO) database, which is updated twice a year, is our source for data on REER. [14] Our dependent variable is constructed as the percentage change of the REER for country i over the period between two years of records p and $p-1$, $\Delta REER_{i,p}$,and is calculated as the percentage change over the period immediately preceding the observation period. For example, for country i,

$$\Delta REER_{i,2005} = \frac{REER_{i,2005} - REER_{i,2000}}{REER_{i,2000}} * 100\%$$

We also use several macroeconomic indicators as controls in our regressions, including general government expenditures, the current-account balance, and monetary policy rates. We use the capital-account control index (CA) as an indicator of the extent of capital controls, [15] and we use the directional-control level of either inflows (KA *Inflow*) or outflows (KA *Outflow*) as robustness checks. We use the World Bank's WDI database for data on GDP per capita in U.S. dollars calculated in purchasing-power-parity (PPP) terms to control for initial conditions.

We construct an indicator for the extent of sterilization using data on central-bank balance sheets using IMF's International Financial Statistics (IFS) database. The database's Net Foreign Assets of the Central Bank series and Monetary Base series are used to measure central-banks assets and liabilities. We calculate an indicator of the extent of sterilization policies implemented by the central bank in line with Aizenman and Glick (2009), where:

$$Sterilization_{i,p} = \frac{\Delta NFA_{i,p} - \Delta MB_{i,p}}{MB_{i,p-1}}$$

[13] Erik Feyen and Diego Sourrouille, "FinStats 2019: A ready-to-use tool to benchmark financial sectors across countries and over time," World Bank 2019.
[14] The MPO database is and report are available on line at https://www.worldbank.org/en/publication/macro-poverty-outlook. The public version of the MPO database does not include the REER or interest data used in this study, but this data may be obtained from the authors.
[15] See Fernández et al. (2016). This is a de jure measure of capital controls based on IMF's Annual Report on Exchange Arrangements and Exchange Restrictions, which also measures the overall control level.

which is constructed as the difference between the change of net foreign asset ($NFA_{i,p}$) and the change of monetary base (MBi,p) normalized by the lag of the monetary base for country i over the 5 year period p.[16] When central banks actively manage their balance sheets to counter the impact of foreign capital inflows, they issue (or sell) market instruments to reduce (or increase) liquidity in the domestic economy, thereby controlling the expansion of the monetary base. [17] In this context, the level of NFAs tends to increase relative to the domestic monetary base: the ratio between them continues to rise as countries actively manage the accumulation of NFAs and falls when they are unable to counter the expansion of the domestic monetary base such that $\Delta M \rightarrow \Delta NFA$, which boosts the monetary base until it equals or exceeds the accumulated NFAs. As a result, the higher the ratio, the larger the central bank's intervention to offset foreign-currency inflows.

Data panels are constructed over five-year intervals, with observations on natural resources made at the beginning and end of each interval. Level-type indicators are observed at the beginning of each five-year interval. All indicator changes are computed over the five-year intervals, with average yearly changes included when yearly data are available.

Empirical Approach

This study follows the empirical approach used by Cust (2015), but it focuses on the appreciation of the REER as the main variable of interest. A reduced-form macro equation is used to evaluate how financial development ($FinDev$) and sterilization ($Sterilization$) affect the REER. This first reduced-form equation (Equation 1) is estimated as:

$$\Delta REER_{i,p} = \alpha_0 + \alpha_1 RD_{i,p} + \alpha_3 FinDev_i + \alpha_2 RD_{i,p} \times FinDev_i + \gamma X_{i,p} + \epsilon_{i,p}$$

in which subscripts I and p indicate country and 5-year period, respectively. The dependent variable $\Delta REER_{i,p}$ is the percentage change of the REER for country i over the period between two years of records p and $p-1$; $RD_{i,p}$ is the resource discovery indicator variable; $(FinDev_i)$[18] is an indicator of the level of financial development; $RD_{i,p} \times FinDev_i$ is an interactive variable which identifies whether deeper financial sectors have a stronger impact in countries with resource discoveries; and Xi identifies the set of additional control variables. In particular, all regressions include a control for initial conditions, $RGDP\_PC_{i,p}$, real GDP per capita at the beginning of each observation period and additional controls for macroeconomic conditions: $BCA\_GDP_{i,p-1}$, the current-account balance observed with a one-period lag to control for endogeneity:$KA_{i,p}$capital controls indicators; $\Delta GGX\_GDP_{i,p}$ the change in government spending as a percentage of GDP over the period preceding the observation period; and $\Delta PRate$ and $\Delta STRate$, the changes in the policy rate and short-term

[16] Following Aizenman and Glick (2009).
[17] Following Mehrotra (2012).
[18] Given the shorter series of the indicator (which only starts, an average value of each country is calculated over available years as the final proxy for financial development.

interest rate respectively, controlling for the monetary policy stance[19]. Table 1, below, presents the summary of these variables and their definitions.

A second reduced form equation is used to analyze the impact of changes in central banks' balance sheets as an alternative explanatory variable for REER appreciation to financial development. we conjecture that monetary policies aimed at containing the adverse effects of capital inflows may be effective in dampening the effects of the resource discovery, and the ability of central banks to manage their balance sheets is influenced by the level of financial development.[20] The second reduced-form equation (Equation 2) takes the form:

$$\Delta REER_{i,p} = \alpha_0 + \alpha_1 RD_{i,p} + \alpha_2 RD_{i,p} \times Sterilization_{i,p} + \alpha_3 Sterilization_{i,p} + \gamma X_{i,p} + \epsilon_{i,p}$$

where RD are the resource discovery indicators, $Sterilization_{i,p}$ is the measure of the active management of the central bank's balance sheet, RDxSterilization is the interactive variable that identifies sterilization activities in resource rich countries and Xi the set of macroeconomic controls.

Finally, a third reduced-form equation is estimated to analyze whether there is relationship between sterilization policies, resource discoveries and financial development. We investigate whether a country's use of sterilization policies (at the beginning of the observation period) is linked to the breadth of is financial development (after controlling for initial conditions and macroeconomic factors). The third reduced-form equation (Equation 3) takes the form:

$$Sterilization = c + RD + \alpha_1 FinDev_{i,p} + \gamma X_{i,p} + \epsilon_{i,p}$$

where *Sterilization* is defined above as the measure of balance management of central banks, RD the dummy identifying countries that experienced a resource discovery, *Findev* is the financial development indicator and X the standard set of macroeconomic control variables. We use broaden the set of financial development indicators to include: the number of bank accounts per 100,000 inhabitants, the Doing Business access to credit score value, the size of the stock exchange turnover, the share of the stock market to GDP, the share of total credit to the government and SOEs, and the ratio of private-sector credit to public-sector credit.[21] We control for the macroeconomic stance by using the size of BoP balance and the public fiscal deficit. Care was taken of observing the initial period values to minimize potential endogeneity issues.

[19] Policy rates are taken from the MPO database, and the policy rate for each country is identified by its country economist.

[20] Absent the management of central banks' balance sheets, an increase in foreign reserves at the central bank following currency inflows to the banking sector would increase the monetary base through and increase in banks' deposits. Where central bank sells a bond (increases its non MB liabilities) if offsets the increase of net foreign assets on its balance sheet.

[21] *SOE_Credit* is defined as credit provided by domestic commercial banks to the government and SOEs as a share of GDP.

Panel data techniques were used with robust standard errors. Alternative estimation methodologies are used to check the robustness of results after controlling for both country and time effects and heteroskedastic errors, and lagged dependent variables are used in the estimations for instrumental variables. Interactive terms test for possible collinearity. The robustness of results is also checked against a range of alternative indicators for the variables in the baseline regressions.

Table 1. Definition of Variables

Variable	Definition	Source
$\Delta REER_{i,p}$	$\Delta REER_{i,2005} = \frac{REER_{i,2005} - REER_{i,2000}}{REER_{i,2000}} \times 100\%$	The World Bank MFMod database
$RD_{i,p}$	$RD_{i,p} = 1,$ if $\frac{Total\ Resource_{i,p} - Total\ Resource_{i,p-1}}{RGDP_{i,p-1}} \times 100\% > 5\%.$	The World Bank Wealth Accounts (only data for oil and gas resources are considered)
$RD2_{i,p}$	Same as $RD_{i,p}$ but threshold is 10%	
$RD3_{i,p}$	Same as $RD_{i,p}$ but threshold is 15%	
$FinDev$	Number of commercial bank branches per 100,000 adults; average value across all periods	The World Bank's FinStats database
$Sterilzation_{i,p}$	$Sterilzation_{i,p} = \frac{\Delta NFA_{i,p} - \Delta MB_{i,p}}{MB_{i,p-1}}$	The IMF's IFS database
$KA_{i,p}$	De jure measure of overall capital controls	Fernández et al. (2016)
KA Inflow	Overall capital inflow restrictions index	
KA Outflow	Overall capital outflow restrictions index	
$logRGDP\_PC_{i,p}$	Log of Real GDP per capita	The IMF's World Economic Outlook
$\Delta GGX\_GDP_{i,p}$	Change in government spending as a share of GDP	The IMF's World Economic Outlook
$BCA\_GDP_{i,p-1}$	One-period lag of the current-account balance as a share of GDP	The IMF's World Economic Outlook
$\Delta PR_{i,p}$	Change in the monetary policy rate	The World Bank's MFMod database

$\Delta ST R_{i,p}$	Change in the short-term rate	The IMF's World Economic Outlook
Credit Private/Public	Domestic credit to private sector divided by credit to Government and SOEs	The WB WDI & FinStats database
Credit Private/GDP	Domestic credit to private sector as a percentage to GDP	The WB WDI
Credit Public/GDP	Credit to Government and SOEs as a percentage to GDP	The WB FinStats database
ERS	Exchange rate stability: $\frac{0.01}{0.01+stdev(\Delta \log exchange\_rate)}$	Aizenman etc. (2008) http://web.pdx.edu/~ito/w14533.pdf
MPI	Monetary policy independence: $1-\frac{corr(i,j)-(-1)}{1-(-1)}$ *i* is the home country policy rate; *j* is the base country policy rate; the higher the more independent.	Aizenman etc. (2008) http://web.pdx.edu/~ito/w14533.pdf

Estimation Results

Consistently with previous empirical studies and the broader economic literature, resource discoveries appear to be significantly associated with REER appreciation. The results suggest a positive coefficient for resource discovery (α_1) across all regressions (column 1 in Table 2). As expected, measures of capital-account controls appear to have a significant dampening effect on changes in the REER (columns 1–5), as all coefficients are significantly negative. These results would be in line with standard macroeconomic theories that predict that the appreciation of the REER is derived from international capital flows (independently from resource discoveries). As the "trilemma theory"[22] predicts, capital controls would play an important role in determining the behavior of the REER, as a more tightly regulated capital account (denoted by a higher KA value) leads to a more stable exchange rate, other conditions being equal.

Financial development appears to significantly reduce REER appreciation in countries that experienced resource discoveries. The interactive term in Equation (1) was found to be significant and negative (columns 2–6 in Table 2). However, aside from the interactive term, financial development indicators were not found to have a significant impact on the REER, suggesting efficiency gains from financial development may be reaped in terms of factor allocation in resource rich countries. We tested our results for robustness against alternative specification(s) of Equation 1 to control for the effects of domestic macroeconomic policies, especially the impact of the fiscal deficit and domestic monetary policy rates on the REER.

[22] Obstfeld, Maurice and Alan Taylor (2004) "Global capital markets: integration, crisis and growth," Cambridge University Press.

Neither was found to significantly alter the results with respect to our variables of interest (columns 3, 5, and 6 in Table 2). In addition, we tested for robustness of our results against initial conditions in the external sector (column 4 in Table 2).

Central banks' balance sheet management policies appear to have a significant impact in containing the appreciation of the REER. We find this result holds regardless of whether a country has recently experienced a natural resource discovery or otherwise (columns 2–6 in Table 3). However, we find a significantly larger effect of central bank policies in resource rich countries. (column 2–4 in Table 3). Robustness checks suggest that the estimated impact of sterilization policies maintains the same significance and direction after controlling other macroeconomic explanatory variables including change of government expenditure, balance of payments and monetary policy rate.

Results remain consistent after using alternative indicators for the variables of interest and alternative econometric methodologies. We run the above reduced form estimation with different indicators for financial development, capital controls on inflows and on outflows s an alternative to the more general capital control index.[23] In addition, we tested whether results remain consistent if resource discoveries are defined as changes in resource stocks exceeding 10 or 15 percent of GDP, rather than 5 percent, as in the baseline regressions. We also apply alternative estimation methodologies, including applying Generalized Least Squares for panel data and using fixed effects for both country and time and using instrumental-variable methodologies with lagged dependent variables.[24] T statistics were run to test whether the results also hold for a subgroup of countries with at least one major resource discovery over the sample period. Some results for these robustness checks are presented in the appendix.[25]

We do not find significant evidence of a direct link between financial development and active balance sheet management policies after controlling for macroeconomic factors. Overall, our evidence does not suggest that more developed financial sectors or resource discoveries are associated with higher levels of sterilization across countries (Table 4 column 1–8). We do find some evidence that countries with deeper financial systems appear to engage less in sterilization policies (table 4 column 2 and 3) and that this result appears to hold across all countries. We interpret this result as broadly consistent with those in Table 1, where we find that countries with higher financial development indicators experience less REER appreciation and thus would need to engage less in sterilization policies. We also find some evidence that active balance sheet management policies appear to be negatively associated with the relative share of public sector credit. These results appears to be in line with findings in previous studies suggesting a relatively high share of credit to the public sector tends to weaken the effectiveness of monetary policy (Chen, Li, and Tillmann 2019). We find our results appear to be robust to alternative specifications for macroeconomic policy indicators, such as capital-account controls and the fiscal policy stance.

[23] In particular, we used the number of bank branches per 10,000 inhabitants as an alternative indicator for financial development.
[25] Others are available upon request.
[25] Others are available upon request.

Table 2. Real Exchange Rate Movements and Financial Development

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Dep Var: $\Delta REER_{i,p}$					
$RD\ \alpha_1$	1.910	9.987*	9.691*	8.250	14.73**	18.84**
	(0.601)	(0.0709)	(0.0839)	(0.141)	(0.0273)	(0.0168)
$RD \times FinDev\ \alpha_2$		-0.617*	-0.645**	-0.623**	-0.798**	-0.920**
		(0.0522)	(0.0464)	(0.0495)	(0.0286)	(0.0197)
$FinDev\ \alpha_3$	-0.177	-0.112	-0.105	-0.0737	-0.156	-0.0919
	(0.100)	(0.321)	(0.356)	(0.531)	(0.198)	(0.502)
KA	-11.62**	-11.08**	-11.24**	-12.07**	-15.35**	-16.38**
	(0.0357)	(0.0442)	(0.0426)	(0.0295)	(0.0183)	(0.0298)
$logRGDP\_PC$	-0.000127	-0.000108	-0.000102	-0.000201*	-0.000139	-0.000344***
	(0.133)	(0.200)	(0.229)	(0.0566)	(0.146)	(0.00890)
ΔGGX_GDP			0.145			
			(0.582)			
BCA_GDP_{p-1}				0.357		
				(0.174)		
ΔPR					0.168	
					(0.459)	
ΔSTR						0.583
						(0.234)
$Constant$	14.07***	12.00***	10.57**	14.54***	16.72***	20.12***
	(0.000833)	(0.00534)	(0.0349)	(0.00134)	(0.000835)	(0.00100)
Observations	261	261	259	258	212	174
R-squared	0.032	0.047	0.047	0.057	0.074	0.114

Note: p-val in parentheses; *** p<0.01, ** p<0.05, * p<0.1; RD: resource discovery; *FinDev:* financial development indicator; interaction term of *RD* X *FinDev* (α_2).

Table 3. Real Exchange Rate Movements and Sterilization Measures

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Dep Var: $\Delta REER_{i,p}$					
$RD\ \alpha_1$	2.471	2.003	0.964	-0.674	1.482	2.529
	(0.580)	(0.642)	(0.828)	(0.877)	(0.738)	(0.644)
$RD \times Sterilization$ α_2		-0.156***	-0.150***	-0.140***	-0.0909	-0.00694
		(0.00286)	(0.00423)	(0.00702)	(0.114)	(0.931)
$Sterilization\ \alpha_3$	-0.0578**	-0.0174	-0.0206	-0.00555	-0.0153	-0.00477
	(0.0179)	(0.517)	(0.446)	(0.841)	(0.579)	(0.868)
KA	-9.899	-9.151	-9.160	-8.535	-10.53	-11.11
	(0.137)	(0.154)	(0.154)	(0.180)	(0.117)	(0.177)
$logRGDP\_PC$	-0.000150	-0.000135	-0.000142	-0.000306***	-0.000159	-0.000386**
	(0.139)	(0.168)	(0.149)	(0.00902)	(0.114)	(0.0133)
ΔGGX_GDP			0.343			
			(0.340)			
BCA_GDP_{p-1}				0.798***		
				(0.00815)		
ΔPR					0.399	
					(0.282)	
ΔSTR						-0.217
						(0.799)
$Constant$	14.41***	12.87***	9.725*	16.81***	14.33***	17.36***
	(0.00078)	(0.0020)	(0.065)	(0.00017)	(0.00097)	(0.0026)
Observations	116	116	116	114	109	73
R-squared	0.089	0.160	0.167	0.214	0.102	0.101

Note: p-val in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Table 4. Financial Development and Sterilization Measures

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Indicator for FinDev[1]*:*		Stock_TO	DB_credit	BankCredit	TotCredit	PublicCredit	# of Account
RD	-0.271	-0.669***	-0.271	-0.288	-0.214	-0.225	-0.232
	(0.136)	(0.000876)	(0.222)	(0.109)	(0.239)	(0.217)	(0.227)
Indicator for FinDev[1]		-0.000254*	-0.0138	-0.00714	0.00622	0.00472	-0.0196*
		(0.0750)	(0.753)	(0.180)	(0.238)	(0.291)	(0.0594)
logRGDP_PC	0.176	0.192	0.462**	0.245	0.0675	0.0869	0.221
	(0.237)	(0.352)	(0.0272)	(0.133)	(0.638)	(0.544)	(0.142)
H Income Dummy	0.250	0.182	0.251	0.163	0.0263	0.0818	0.242
	(0.548)	(0.666)	(0.566)	(0.686)	(0.947)	(0.833)	(0.556)
ERS	-0.0201	0.126	-0.331	-0.106	-0.0170	0.0180	-0.155
	(0.959)	(0.794)	(0.541)	(0.789)	(0.965)	(0.963)	(0.699)
MPI	1.393	0.704	1.816	1.473	1.331	1.336	1.341
	(0.123)	(0.462)	(0.162)	(0.105)	(0.136)	(0.136)	(0.140)
BCA_GDP_{p-1}	0.0392*	0.0558**	0.0192	0.0368	0.0406*	0.0400*	0.0350
	(0.0803)	(0.0422)	(0.510)	(0.101)	(0.0615)	(0.0685)	(0.127)
ΔGGX_GDP	0.0164	0.01000	0.0279	0.0166	0.0183	0.0188	0.0134
	(0.528)	(0.779)	(0.587)	(0.528)	(0.483)	(0.478)	(0.599)
ΔPR	-0.00835	-0.0232	0.00932	-0.00880	-0.00446	-0.00499	-0.00718
	(0.680)	(0.381)	(0.842)	(0.656)	(0.815)	(0.795)	(0.719)
Constant	-1.989	-1.449	-4.874**	-2.173	-1.276	-1.433	-2.066
	(0.209)	(0.458)	(0.0161)	(0.179)	(0.364)	(0.323)	(0.187)
Observations	121	84	76	121	121	121	121
R-squared	0.106	0.180	0.146	0.117	0.119	0.116	0.126

Note: p-val in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

[1] different indicators are used for financial development, including: 1). # of Account – Accounts Per Thousand Adults, Commercial Banks; (2). Stock_TO – Stock Market Turnover Ratio (%);3). DB_credit – WB Doing Business -- getting credit; 4. BankCredit – Domestic credit to private sector by banks (% of GDP); 5). TotCredit – Domestic credit to private sector (% of GDP); 6). PublicCredit – Credit to Government and SOEs / GDP (%). Regressions with 1). Stock_Size – StockMarket Capitalization / GDP (%); 2). Bond_Size – Total Bond Issuance Volume / GDP (%) were also run.

IV. CONCLUSION

To date, most strategies for managing the adverse macroeconomic effects of natural resources have focused on fiscal policies. While previous analyses have highlighted the important role of institutions, relatively little attention has been devoted to the specific role of financial development. This study builds on the results of previous analytical work, which suggests that a country's level of financial development tends enhance growth potential and to mitigate the negative effects of a resource discovery. This study goes further by examining more broadly the role of financial development on the REER appreciation following a resource discovery as well as the observed impact of financial policies to counter the resource curse. It also analyzes whether the level of financial development is associated with the ability of central banks to actively their balance sheets.

Our findings suggest that both a deeper and more developed financial sector and active monetary policies have a significant mitigating effect on the appreciation of the REER. We see our results on financial sector development as characterizing the beneficial features that the broad institutional environment plays in resource rich countries, as evinced from the literature. In addition, our findings also lend support to the recommendations of the IMF (2012), calling for a stronger role of monetary policies in macroeconomic management of the countries suffering from the resource curse. However, we find no significant evidence of a direct relationship between the two elements. This suggests two separate mechanisms may be driving the results.

We argue that our results underscore the importance of capitalizing on the financial sector in order to mitigate the effects of the resource curse. We suggest that, in addition to the role of particular financial sector policies, more developed financial sectors allow for efficiency gains in factor allocation and risk dispersion which may be key factors in mitigating the effects of the resource curse in countries that experience resource discoveries.

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V. APPENDIX: ROBUSTNESS CHECKS

Table A1: Real Exchange Rate Movement and Financial Development: Robustness Check A

	(1)	(2)	(3)	(4)
	Baseline	Year Dummy	GLS	Robust Std
VARIABLES	Dep Var: $\Delta REER_{i,p}$			
RD α_1	9.987*	11.36**	9.987*	9.987
	(0.0709)	(5.511)	(5.443)	(8.201)
$RD \times FinDev$ α_2	-0.617*	-0.599*	-0.617**	-0.617*
	(0.0522)	(0.315)	(0.313)	(0.358)
FinDev α_3	-0.112	-0.101	-0.112	-0.112*
	(0.321)	(0.112)	(0.111)	(0.0648)
KA	-11.08**	-12.25**	-11.08**	-11.08
	(0.0442)	(5.476)	(5.418)	(7.731)
$logRGDP\_PC$	-0.000108	-0.000124	-0.000108	-0.000108
	(0.200)	(8.41e-05)	(8.33e-05)	(7.70e-05)
Constant	12.00***	-1,838**	12.00***	12.00**
	(0.00534)	(895.1)	(4.221)	(4.802)
Observations	261	261	261	261
R-squared	0.047	0.062	N/A	0.047

Note: p-val in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table A2: Real Exchange Rate Movement and Sterilization: Robustness Check A

	(1)	(2)	(3)	(4)
	Baseline	Year Dummy	GLS	Robust Std
VARIABLES	Dep Var: $\Delta REER_{i,p}$			
RD α_1	2.003	0.640	2.003	2.003
	(0.642)	(4.403)	(4.184)	(4.430)
$RD \times Sterilization$ α_2	-0.156***	-0.151***	-0.156***	-0.156*
	(0.00286)	(0.0510)	(0.0497)	(0.0922)
Sterilization α_3	-0.0174	-0.0219	-0.0174	-0.0174
	(0.517)	(0.0268)	(0.0260)	(0.0193)
KA	-9.151	-8.626	-9.151	-9.151
	(0.154)	(6.365)	(6.208)	(6.484)
logRGDP_PC	-0.000135	-0.000122	-0.000135	-0.000135
	(0.168)	(9.75e-05)	(9.47e-05)	(0.000117)
Constant	12.87***	2,634	12.87***	12.87***
	(0.00196)	(1,976)	(3.950)	(4.439)
Observations	116	116	116	116
R-squared	0.160	0.174	N/A	0.160

Note: p-val in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table A3: Real Exchange Rate Movement and Financial Development: Robustness Check B

	(1)	(2)	(3)	(4)	(5)
	Baseline	RD2[1]	RD3[2]	KA Inflow	KA Outflow
VARIABLES	Dep Var: $\Delta REER_{i,p}$				
RD α_1	9.987*	10.45*	12.98**	9.906*	9.796*
	(0.0709)	(5.618)	(5.768)	(5.534)	(5.487)
$RD \times FinDev$ α_2	-0.617*	-0.748**	-0.922**	-0.624*	-0.619*
	(0.0522)	(0.337)	(0.359)	(0.317)	(0.316)
FinDev α_3	-0.112	-0.114	-0.102	-0.0997	-0.116
	(0.321)	(0.112)	(0.111)	(0.112)	(0.112)
KA	-11.08**	-10.26*	-9.794*		
	(0.0442)	(5.447)	(5.447)		
KA Inflow				-9.109	
				(5.837)	
KA Outflow					-10.37**
					(4.698)
logRGDP_PC	-0.000108	-0.000103	-0.000103	-9.05e-05	-0.000114
	(0.200)	(8.47e-05)	(8.49e-05)	(8.35e-05)	(8.43e-05)
Constant	12.00***	11.98***	11.43***	10.39**	12.37***
	(0.00534)	(4.244)	(4.200)	(4.138)	(4.227)
Observations	261	261	261	261	261
R-squared	0.047	0.050	0.057	0.040	0.049

Note: p-val in parentheses; *** p<0.01, ** p<0.05, * p<0.1; [1.] For RD2, a major resource discovery is defined as a change larger than 10 percent of GDP, instead of 5 percent in the Benchmark; [2.] For RD3, similarly, the threshold of 15 percent of GDP is used.

Table A4: Real Exchange Rate Movement and Sterilization: Robustness Check B

	(1)	(2)	(3)	(4)	(5)
	Baseline	RD2[1]	RD3[2]	GLS	Year Dummy
VARIABLES	Dep Var: $\Delta REER_{i,p}$				
RD α_1	2.003	-0.560	-0.440	1.229	2.286
	(0.642)	(4.391)	(4.577)	(4.335)	(4.243)
$RD \times Sterilization$ α_2	-0.156***	-0.161***	-0.162***	-0.159***	-0.152***
	(0.00286)	(0.0513)	(0.0517)	(0.0514)	(0.0508)
Sterilization α_3	-0.0174	-0.0197	-0.0207	-0.0154	-0.0195
	(0.517)	(0.0267)	(0.0263)	(0.0269)	(0.0266)
KA	-9.151	-8.414	-8.587		
	(0.154)	(6.274)	(6.300)		
KA Inflow				-4.485	
				(7.117)	
KA Outflow					-10.21*
					(5.283)
logRGDP_PC	-0.000135	-0.000118	-0.000114	-0.000106	-0.000154
	(0.168)	(9.79e-05)	(9.80e-05)	(9.62e-05)	(9.73e-05)
Constant	12.87***	13.11***	13.14***	10.48**	13.98***
	(0.00196)	(4.055)	(4.033)	(4.001)	(3.920)
Observations	116	116	116	116	116
R-squared	0.160	0.162	0.162	0.148	0.173

Note: p-val in parentheses; *** p<0.01, ** p<0.05, * p<0.1; [1.] For RD2, a major resource discovery is defined as a change larger than 10 percent of GDP, instead of 5 percent in the Benchmark; [2.] For RD3, similarly, the threshold of 15 percent of GDP is used.