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Taming Private Leviathans: Regulation versus Taxation

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Abstract

Abstract: This paper explores the interplay between top wealth and policies namely regulation and taxation exploiting variation in exposure to international commodity prices. Using a global panel dataset of billionaire's net worth, results point to a positive relationship between commodity prices and the concentration of wealth at the top. Regulation especially pertaining to competition is found to limit the effects of commodity price shocks on top wealth concentration while taxation has little effect. Moreover, commodity price shocks crowd out non-resource tax revenue hence limiting the scope for income transfers and redistribution. Results are consistent with the primacy of *ex ante* interventions over *ex post* ones to address top wealth inequality.

JEL Classification : D31 ; D63 ; H26 ; H20 ; O13

Keywords: inequality; wealth concentration, competition, tax, natural resources, development

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"any contract… in restraint of trade" and "Every person who shall monopolize, or attempt to monopolize…shall be deemed guilty of a felony" – US Sherman Act (1890)

1. Introduction

In the late 19th century in the United States, rising inequality, social tensions and oligarchy led the federal government to reinvent itself as a regulator. The Sherman Antitrust Act of 1890 is the foundational federal statute in the development of U.S. competition law.[1] At the time, the gilded age called for a forceful response by the federal government to curb the rising power of the so-called robber barons including Cornelius Vanderbilt, John D. Rockefeller and Andrew Carnegie. Fast forward to today the global rise of a class of billionaires coupled with heightened social tensions raise important questions about what to do about top wealth and income inequality (Wu, 2018). Competition policies and antitrust laws combined with strong enforcement mechanisms have a potentially powerful role to play in shaping the structure of an economy and society over and beyond taxation and redistribution policies. Indeed, protected sectors, cartels or collusion limit the impetus for investment, innovation, and growth (see Aghion and Griffiths, 2005). The present paper explores the interplay between top wealth and policies namely regulation and taxation exploiting variation in exposure to international commodity prices.

The rise of top income and wealth inequality over recent decades is a consistent pattern across the world (Piketty, 2014).[2] Initially the rise of top incomes was documented for the United States and France (Piketty and Saez, 2003; Piketty, 2003), followed by several other advanced economies (Atkinson et al., 2011). Studies on top incomes in developing economies is sparse due to data limitation, but several studies have documented top income trends in developing economies.[3] The rise of top incomes points to a number of concerns including significant welfare losses for workers and associated adverse political consequences (Alesina and Perotti, 1996; Bartels, 2008; Lansing and Markiewicz, 2016). Wealth concentration at the top also raises issues regarding policies including as to whether interventions should be *ex ante* or *ex post* (Fleurbaey and Peragine, 2013; Hsu, 2014).

The jury is still out on what drives the rise of top incomes. The literature has identified several factors driving top income and wealth inequality namely globalization, technology, labor market institutions, decline in competition and fiscal policy—or generally social norms regarding pay inequality (Ma and Ruzic, 2020; Piketty and Saez, 2003; Philippon, 2019; Aghion et al, 2019). Hsu (2014) argues that there are legal roots to top income inequalities which might explains the pervasive higher returns to capital compared to the rate of GDP growth. On the normative front, there is a heated debate on the best approach to address the rise in top incomes. The dominant approach is either to address institutional factors favoring the ability of top income earners to channel rents their way or to reduce the returns to rent seeking by increasing marginal rates of taxation on high incomes (Bivens and Mischel, 2013). More recently a debate has been raging on the use of a wealth tax as an instrument to reduce top incomes (Saez and Zucman, 2019).[4]

[1] The Sherman Act gave way to The Clayton Antitrust Act of 1914.

[2] Notwithstanding the conceptual differences between wealth and inequality, the two terms are used interchangeably thereafter. In the present paper, we use a measure of wealth inequality. As such the focus of the paper is on latter. In practice, measure of income and wealth inequality are strongly correlated. What is more, data on top incomes using tax administration data are more readily available than top wealth.

[3] For studies of wealth and income inequality in developing countries see Banerjee and Piketty, 2005; Leigh and van der Eng, 2009; Freund, 2016; Lopez et al., 2016; and Assouad et al, 2018.

[4] See debate hosted by the Peterson Institute for International Economics: https://www.piie.com/events/combating-inequality-rethinking-policies-reduce-inequality-advanced-economies, accessed May 16, 2020.

In this paper, we document that different institutional arrangements lead to a differentiated effect of (plausibly) exogenous commodity price fluctuations on top incomes.[5] To do so, we combine a global panel dataset from Forbes Magazine on billionaires' net worth with an index of (country specific) commodity terms of trade shocks. Commodity shocks are significant sources of macroeconomic variation but also have important sectoral implications which elucidate linkages with concentration of income at the top. Results show that commodity booms lead to top income concentration, and the effect is economically large. Figure 1(a) globally traces the patterns of commodity shocks and the log differences of billionaire net worth and shows that they co-move. Figure 1(b) replicates the same pattern for developed (left panel) and developing economies (right panel) and shows the positive relationship between commodity price shocks and top incomes stand, regardless of the level of development. This finding is robust to accounting for sector of activity as well as the individual characteristics of billionaires as captured by billionaire fixed effects. The evidence is also suggestive that competition policy weakens the relationship between commodity booms and top incomes, and tax policy has no effect. However, we do find that commodity booms tend to lower tax revenues in the economy hence reducing the scope for income transfers and redistribution.

In addition to the literature on top incomes, this paper contributes to several strands of literature. Specifically, the paper also relates to the so-called "resource curse" literature. The latter has provided (mixed) empirical evidence that countries with large dependence in natural resource grow slower (see survey by Ross et al., 2015) and are also more unequal (Ross, 2001; Sokoloff and Engerman, 2000).[6] Importantly, Mehlum, et al (2006) provides evidence that the effect of natural resources on the economy depend on quality of institutions. Furthermore, the type of natural resource matters with hydrocarbon and mineral resources, categorized as "point source" resources, having a more detrimental impact on growth than "diffuse" resources such as agriculture (see Isham et al., 2005). We contribute to this literature by focusing on the top incomes as opposed to general income inequality while exploring the role of different policy/institutional frameworks. We also find that commodity price shocks emanating from point source lead to more top income concentration than shocks stemming from diffuse resource.

[5] To the extent that commodity prices and stock markets comove, changes in commodity prices also affect billionaires' net worth through changes in stock market valuation. See Arezki, Loungani, van der Ploeg and Venables (2014) and Ing-haw Cheng and Wei Xiong (2014) for a discussion on the respective role of fundamentals and financialization in driving commodity price fluctuations.

[6] For the early contribution to the resource curse literature see Sachs and Warner, 2001.

Figure 1a: Log Differences of Billionaire Net Worth and Commodity Shocks

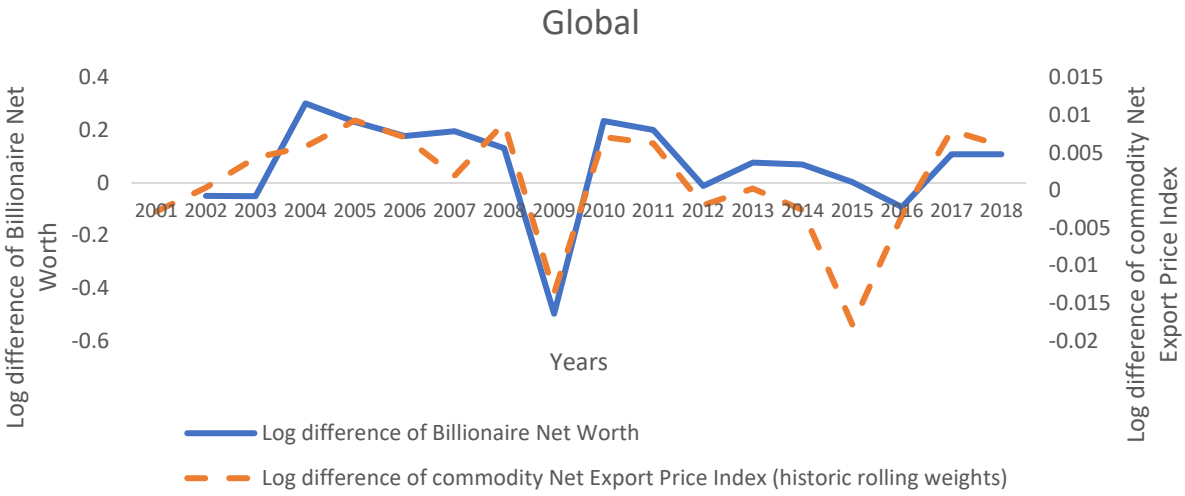
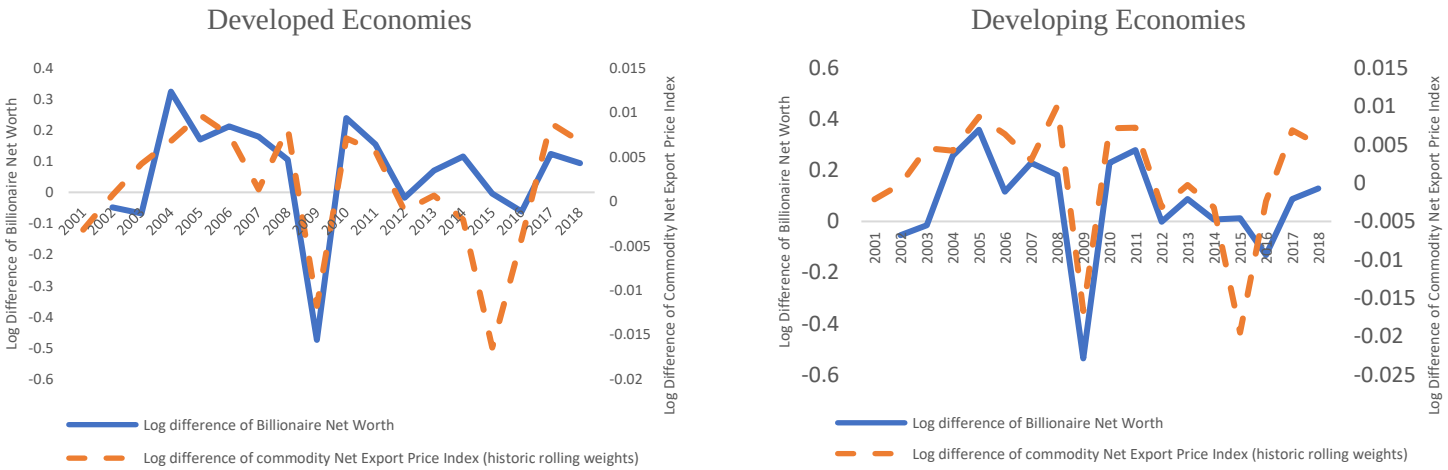


Figure 1b: Log Differences of Billionaire Net Worth and Commodity Shocks – Developing vs Developed Economies



Sources: Forbes Magazine (2001 to 2018); Gruss et al. (2019).

Globalization has led to a significant decrease in the cost of international capital mobility. In turn, this has fueled intense tax competition, which offers multiple opportunities to shift profits or wealth in tax accommodating countries or tax heaven. Any tax coordination at the international level is rendered difficult or nearly impossible (see Rota-Graziosi, 2019). This may explain why taxation appears less efficient than regulation to tame top wealth inequalities as in this paper. Alstadsæter et al. (2018) finds that 10 percent of world wealth is held in tax havens and that this mask important heterogeneity. Andersen et al. (2017) finds that around 15% of the windfall gains accruing to petroleum-producing countries with autocratic rulers is diverted to secret accounts. The emerging debate on curbing top incomes has centered around the wealth tax (Saez and Zucman, 2019). There is indeed a strong theoretical case for a wealth tax especially after calamities such as wars and pandemics, yet its implementation and effectiveness has been challenged. In this paper, we find empirically that both resource and non-resource taxation do not moderate the effect of commodity booms on top incomes.

Further, we find that commodity price shocks reduce non-resource taxes, both direct and indirect. Our findings relate to the volatility of public budgets due to commodity price volatility (Robinson et al., 2017), the resource curse in terms of public finances (Borge et al., 2015). James (2015) establishes a negative relationship between resource and non-resource revenues as the expression of a crowding out effect between these sources of revenue in US states. Our findings further contribute to this literature by documenting certain institutional arrangements can help curb the rise in top incomes.

The remainder of the paper is structured as follows. Section 2 presents the data. Section 3 describes the estimation strategy. Section 4 presents the main results and robustness checks. Section 5 presents additional results. Section 6 concludes.

2. Data

This section presents the data used in the empirical investigation.

2.1 Top Incomes

Data on billionaire net worth (in USD) are used to proxy for top incomes. The data are obtained from Forbes Magazine's updated database of billionaires (2001 to 2018). Billionaires are identified based on their first name, last name, and their profile in Forbes magazine. Information from Wikipedia is used to fill in missing information on billionaire characteristics such as country of citizenship. The number of billionaires in the sample rose from approximate 565 in 2001 to 2,208 in 2018. Forbes Magazine's billionaire database has been used in the literature to study wealth distribution (Piketty, 2014; Bagchi et al., 2016), the international mobility of billionaires (Sanandaji, 2014), the emergence of Russian billionaires (Treisman, 2016), and statistical regularities at the top end of the wealth distribution (Klass et al., 2006) among others. Summary statistics for the sample of analysis are provided in Table A1.

2.2 Commodity Windfalls

Data on commodity price shocks are obtained from the IMF (Gruss and Kebhaj, 2019). The commodity terms of trade index is based on international prices of up to 45 individual commodities, constituting broad categories of energy, metals, food and beverages, and agricultural raw materials. We calculate commodity price shocks by taking the first differences of the log of the price index as shown in equation (1) below.

$$\Delta Log(Index)_{c,t} = \sum_{j=1}^{J} \Delta P_{j,t} \Omega_{c,j,t} \quad (1)$$

Where $P_{j,t}$ is the natural log of the real price of commodity *j* in year *t*. $\Omega_{c,j,t}$ represents the commodity- and country-specific time-varying weights, which are based on three year rolling average trade flows over the previous three calendar years. Similar measures of commodity windfalls have been used by Arezki and Brückner (2012).[7]

[7] We employ a similar measure to calculate specific commodity sub-indices. There are marginal differences in terms of weights, but the methodology is largely the same.

In addition, variables on resource rents are also used to proxy for commodity windfalls. The data on natural resource rents come from the Changing Wealth of Nations dataset of the World Bank (2011) available from the World Bank's World Development Indicators (WDI). Natural resource rents are defined as the difference between the unit price of resources and their unit cost of extraction, multiplied by the volume of resources extracted. Total natural resources rents are the sum of oil rents, natural gas rents, coal rents (hard and soft), mineral rents, and forest rents. The data have been widely utilized in the literature (Klomp and de Haan, 2016; Arezki and Gylfason, 2013). Summary statistics for the sample of analysis are provided in Table A1.

2.3 Tax data

Tax data are obtained from the UNU-WIDER ICTD government revenue dataset (Prichard et al, 2014). The dataset combines several sources of tax data compiled from IMF Article IV reports, thereby ensuring extensive coverage. These include IMF Government Finance Statistics (GFS), World Bank World Development Indicators (WDI), OECD Tax Statistics, OECD Revenue Statistics in Latin America dataset, CEPAL Tax Statistics, and the AEO African Fiscal Performance. The dataset includes a separate category for resource tax revenues, in addition to several other tax breakdowns. Data is available from 1980 to 2017. Summary statistics for the sample of analysis are provided in Table A1.

3. Estimation Strategy

In this section we present our empirical strategy.

To explore the effect of commodity price shocks on billionaire net worth we estimate the following equation:

$$LnBLNW_{i,t} = \alpha_0 + \beta_1 DflnComPri_{c,t} + \gamma_Z Controls_{c,t} + \tau_t + \upsilon_i + \varepsilon_{i,t} \quad (2)$$

Where $LnBLNW$ is the log of billionaire net worth in USD for individual i at time t; $DflnComPri$ is the log difference of the commodity price index in country c, $Controls$ is a vector of country-level controls including structure and size of the economy. τ is the year fixed effects and υ represents individual billionaire fixed effects. As a robustness check, we estimate equation (2) using country fixed effects instead of billionaire fixed effects. Alternatively, we also estimate equation (2) using resource rents in place of commodity price shocks.

Our identification strategy allows us to account for several endogeneity issues. The commodity price shock variables are plausibly exogenous considering most countries are price takers in most commodities they trade hence limiting the simultaneity bias. We limit omitted variable bias in several ways. Billionaire fixed effects are used to account for time-invariant billionaire-specific and country-specific unobservable. This can include education, ability, as well as geographic location and main sector of activity if they do not vary over time. The year fixed effects capture common year shocks. We also include country-level covariates that capture the size and structure of the economy, that could be important predictors of billionaire net worth.

4. Top Income Results

In this section we present our main results.

5.1 Baseline

Table 1 presents our baseline estimates of the effect of commodity price shocks on billionaire net worth. Column 1 provides the estimates accounting for country and year fixed effects. This yields a positive effect of commodity price shocks (booms) on billionaire net worth, statistically significant at the 1% level. However, the estimates may be susceptible to omitted variable bias given several individual-specific time invariant characteristics including inherent ability and family background that may be important predictors of billionaire net worth. In column (2) we replace country fixed effects with billionaire fixed effects to account for these factors. The magnitude of the coefficient drops but the main results remain – positive commodity price shocks increase billionaire net worth, statistically significant at the 1% level. In column 3 we account for the size of the economy, which is positively correlated with billionaire net worth, suggesting scale effects where the net worth of billionaires increases with the size of the economy. Taking the estimates in column 3, a one percentage point increase in the log difference of commodity prices results in a 38% increase billionaire net worth. However, a percentage point increase in the growth rate of commodity prices is a sizeable increase. Thus a 1% increase in commodity prices translates to a 0.004 percent increase in billionaire net worth. A one standard deviation increase in the log difference of commodity prices leads to a 1.3% increase in billionaire net worth, which is roughly 1.5% of the sample mean of billionaire net worth. In table 2 we employ a measure of resource rents as an alternative to commodity price shocks. The results are consistent – resource rents are positively related to billionaire net worth, statistically significant at the 1% level irrespective of whether the specification includes country or billionaire fixed effects. The drawback of this measure is that it is unlikely to be exogenous.

In table 3, we delve deeper into price sub-indices of specific groups of commodities. These commodity divisions include (i) hydrocarbons (crude, coal and natural gas) (ii) Metals and Minerals (base metals, precious metals, fertilizer) and (iii) Agriculture (raw materials), Food and Beverages. We find that hydrocarbons commodity price shocks (booms) are positively related with billionaire net worth, statistically significant at the 1% level, regardless of whether the specification includes country fixed effects (column 1) or billionaire fixed effects (columns 2 and 3). Positive agriculture, food, and beverage commodity price shocks are negatively related to billionaire net worth, statistically significant at the 1% level, regardless of whether the specification includes country fixed effects (column 1) or billionaire fixed effects (columns 2 and 3). In table A2 in the appendix, we explore even more refined breakdowns of the commodity price index. We find that crude oil price shocks (booms) are positively related with billionaire net worth, while positive food price shocks are negatively related to billionaire net worth, both findings statistically significant at the 1% level.

These results complement Isham et al. (2015) that finds countries with natural resources extracted for a narrow geographic region or economic base (point source natural resource) are predisposed to weakened institutional capacity. This may in turn limit the ability of governments to adequately tax top incomes. In contrast, economies with diffuse natural resources (livestock and agricultural produce) do not exhibit similar weak institutional capacity and have more robust growth recoveries. This is also consistent with the natural resource rents results as reported in table 4: billionaire net worth is positively correlated with point source natural resource rents such as oil and natural gas, mineral and coal rents, while negatively correlated with diffuse resources such as forest rents (statistically significant between 1 and 5%).

An alternative approach is to estimate the effect of economic growth on billionaire net worth using commodity price shocks as instruments. These findings are reported in table 5. Hydrocarbon commodity price shocks have a positive and statistically significant effect on economic growth, while price shocks

from metals, minerals, agriculture, food and beverages have a negative and statistically significant effect on economic growth. Economic growth is positively related to billionaire net worth, with the coefficient being statistically significant at the 1% level. These findings stand whether billionaire or country fixed effects are employed. The instruments reject under-identification. The instruments also pass the over-identification test, especially when billionaire fixed effects are used, indicating that the validity of the instruments cannot be rejected. The instruments are also strong, given that they pass the weak identification test, exceeding the Stock and Yogo critical values.

The findings thus far point to a plausible mechanism whereby top income increase in the face of growth or commodity terms of trade shocks. We test whether this is conditional on the degree of market contestability/competition and quality of institutions in the economy. We use the sample average of the control of corruption quality of governance indicator. This captures perceptions of the extent to which public power is exercised for private gain, including both petty and grand. We also use the sample averages of the World Economic Forum's indicators on the intensity of location and market domination. The former measure considers the distortive effect of taxes and subsidies on competition, the extent of market dominance, and competition in services. The market dominance indicator measures perceptions of whether corporate activity is characterized by a few business groups or many firms. For all indicators, higher values imply better governance/market contestability.

Table 6 reports the findings. All interactions between governance/competition and commodity price shocks have negative and statistically significant coefficients. The same results are found when the governance/competition variables are interacted with resource rents. The results indicate that in countries with more contestable markets and good governance, top incomes are less likely to increase as a result of positive commodity price shocks. These findings are consistent with Andersen et al., (2017) that finds that exogenous shocks in petroleum income increase hidden wealth in offshore accounts for economies where institutional checks and balances are weak.[8]

5.2 Robustness Checks

Sector of activity and structure of the economy

The estimates provided thus far are based on parsimonious specifications. In the following, we explore the robustness of the baseline findings along several dimensions. First the structure of the economy may be an important predictor of billionaire net worth. Second the sector of billionaire activity may also matter, to the extent that it varies over time. In tables A3 and A4 we replicate tables 1 and 2 respectively with the inclusion of the share of manufacturing and Agriculture as a percent of GDP as additional covariates. The sign, significance and magnitude are relatively unchanged for the commodity price shock and resource rents coefficients.

The Forbes Magazine database does include data on the billionaire sector of activity that encompasses about 57 sectors of activity. However, this variable is measured with error given a single billionaire can be involved across multiple sectors. Furthermore, the 57 sectors do not seem to be mutually exclusive. We therefore recategorize the 57 sectors into 6 broad categories (see table A7) that include: (a) Agriculture (b) Extractives (c) Manufacturing (d) Services (e) IT and (f) Others. In tables A5 and A6 we present the results for commodity price shocks and resource rents respectively, after accounting for sector fixed effects for the narrow 57 categories, and the broad 6 categories. Our main results are robust. Indeed, the magnitude, sign and significance of the coefficients are similar to our baseline estimates.

[8] See Ross, 2015 for a summary of the literature on the relationship between institutions and commodity booms.

Citizenship versus residency

Finally, our findings are based on the billionaire country of citizenship. The choice is logical given that a billionaire may exert greater influence in the country of her or his citizenship. However, this may not always be the case, and billionaires may have greater influence in their place of residence. Furthermore, there is some ambiguity in the case of dual citizenship, with the database in some cases assigning the citizenship at birth. In 2001, 1.2 percent of billionaires in the sample were not residents in their country of citizenship. This grew to 9.3 percent in 2018. Thus, we reproduce our baseline results using billionaire residency instead of citizenship in table A8. Our main results are robust.

5. Additional Results

In this section, we explore additional results related to tax policies and tax revenue mobilization following commodity price shocks.

Interaction with Taxes

We investigate whether higher taxes lessen the positive effect of commodity shocks and natural resource rents on billionaire net worth. Countries with greater capacity to tax may be able to capture some of the windfalls from commodity booms by extracting revenues from top incomes. As reported in table 7, we find no such effects. The coefficient of the interaction terms between tax revenues and commodity price shocks is statistically insignificant. This remains the case if we interact commodity price shocks with resource taxes, or the ratio of indirect over direct taxes. The results are similar when using resource rents, bar one exception. The interaction between total resource rents and the ratio of indirect over direct taxes is positive and statistically significant, albeit at the 10% level. The implication may be that a tax structure that favors indirect taxes allows billionaires to gather a larger share of commodity windfalls.

Effects of commodity price shocks on taxes and social contributions

The inability of taxes to lessen the effects of commodity price shocks on top incomes, raises the question as to whether such shocks have direct effect on taxes themselves. In Table 8 we regress tax revenues as a percentage of GDP (excluding revenues from resources) on the log differences of the commodity price index. We uncover a negative coefficient for commodity price shocks, statistically significant at the 1 % level (column 1, table 7). These results are mirrored in table A9 using resource rents in place of commodity price shocks. Commodity price booms are associated with weakening non-resource tax capacity, which may explain why the effect of commodity price shocks on billionaire net worth are unaffected by the country's tax rates. Looking at subcomponents of the commodity price indices, hydrocarbons and agriculture, food and beverages have negative coefficients, statistically significant at the 10% level (column 2, table 8). Breaking down these sub-categories even further, base metals, coal and natural gas price shocks (commodity booms) have negative coefficients, statistically significant at least at the 10% level (column 3, table 8). The crude oil price shock variable has a negative effect but is statistically insignificant. The findings for the breakdown of resource rents are provided in column 2 of Table A9. Oil and natural gas rents are negatively related to tax revenues, the coefficient being statistically significant at the 1% level. This provides mixed evidence as to whether point source resource booms as opposed to diffused resource booms may weaken the tax capacity of economies.

We unpack these findings further by investigating the effects of commodity price shocks on the composition of tax revenues (as a share of GDP). As reported in table A10. The log difference of the commodity price index is negatively related to direct and indirect taxes, statistically significant at the 1% and 5% level

respectively. There is a positive relationship with resource tax revenues, but the coefficient is not statistically significant. Table A11 replicates the findings of Table A10 using resource rents in place of commodity price shocks. Total resource rents are positively correlated with resource tax revenues, as expected, the coefficient being statistically significant at the 10% level. Resource rents are also negatively corrected with indirect taxes, with the coefficient being statistically significant at the 1% level. However, there is no statistically significant relationship with direct taxes. The evidence points to commodity price booms lowering non-resource tax revenues across the board, whether direct or indirect. However, the evidence is weaker with regards to resource rents and direct taxes.

An additional result we explore is whether commodity price shocks and resource rents have any effects on social contributions (as a % of total revenue). Results are presented in table A12. The coefficient for the log differences of commodity prices is negative and statistically significant at the 1% level (column 1, table A12). We find similar findings for natural resource rents - the coefficient is negative and statistically significant at the 1% level (column 3, Table A12). There are barely any statistically significant results for the sub-price indices with the exception of metals and minerals with a negative coefficient that is statistically significant at the 10% level (column 2, table A12). However, the findings are stronger when using with resource rates with coefficients for oil and natural gas rents as well as mineral and coal rents being negative and statistically significant at the 5% level. The results are suggestive that commodity price booms are negatively related to social contributions.

6. Conclusion

In this paper we explored the relationship between commodity booms and top incomes using billionaires net worth. Our main finding is that commodity booms increase billionaire net worth. We find that the type of resource matters – price shocks from point source resources such as hydrocarbons, where rents are more easily captured, are more likely to raise top incomes while price shocks from diffuse source resources are not. The positive relationship between commodity price shocks and top incomes is attenuated by a higher degree of competition in markets but is unaffected by taxes. In fact, we find that commodity price shocks tend to reduce the non-resource component of both direct and indirect taxes hence limiting scope for income transfers and redistribution. These findings contribute to the current policy debate on curbing the rise in top incomes that has been focused on wealth taxes as a possible instrument. While there is a strong rationale for a wealth tax especially following calamities its implementation can be challenging considering sophisticated tax avoidance for high net worth individuals. Our empirical finding highlighting the potency of competition policy is consistent with the primacy of *ex ante* interventions over *ex post* ones to address top income inequality.

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Table 1: Price Shocks and Billionaire Net Worth

Model	**Country and Year Fixed Effects**	**Billionaire and Year Fixed Effects**	**Billionaire and Year Fixed Effects**
Dependent Variable	**Log of Billionaire Net Worth (in Billions)**		
	(1)	**(2)**	**(3)**
Log difference of commodity Net Export Price Index (historic rolling weights)	0.622***	0.387***	0.380***
	(0.187)	(0.148)	(0.146)
Log of GDP (constant 2010 US$)			0.145***
			(0.053)
Constant	0.888***	0.467***	-3.673**
	(0.030)	(0.030)	(1.526)
Country Fixed Effects	YES	NO	NO
Billionaire Fixed effects	NO	YES	YES
Year Fixed Effects	YES	YES	YES
Number of observations	20,512	20,512	20,502
R2	0.064	0.285	0.289
Adjusted R2	0.060	0.284	0.289

note: *** p<0.01, ** p<0.05, * p<0.1, Robust Standard Errors Clustered at the Billionaire level

Table 2: Natural Resource Rents and Billionaire Net Worth

Model	**Country and Year Fixed Effects**	**Billionaire and Year Fixed Effects**	**Billionaire and Year Fixed Effects**
Dependent Variable	**Log of Billionaire Net Worth (in Billions)**		
	(1)	**(2)**	**(3)**
Total natural resources rents (% of GDP)	0.012***	0.014***	0.013***
	(0.004)	(0.003)	(0.003)
Log of GDP (constant 2010 US$)			0.087**
			(0.038)
Constant	0.670***	0.451***	-2.037*
	(0.082)	(0.030)	(1.091)
Country Fixed Effects	YES	NO	NO
Billionaire Fixed effects	NO	YES	YES
Year Fixed Effects	YES	YES	YES
Number of observations	18,382	18,382	18,375
R2	0.066	0.276	0.277
Adjusted R2	0.062	0.275	0.277

note: *** p<0.01, ** p<0.05, * p<0.1, Robust Standard Errors Clustered at the Billionaire level

Table 3: Disaggregated Commodity Price Shocks and Billionaire Net Worth

Model	**Country and Year Fixed Effects**	**Billionaire and Year Fixed Effects**	
Dependent Variable	**Log of Billionaire Net Worth (in Billions)**		
	(1)	**(2)**	**(3)**
Log Difference of Hydrocarbons Commodity Index	0.213***	0.226***	0.224***
	(0.081)	(0.067)	(0.067)
Log Difference of Metals and Minerals Commodity Index	0.366*	0.062	0.046
	(0.217)	(0.144)	(0.142)
Log Difference of Agriculture, Food, and Beverages Commodity Index	-0.574***	-0.701***	-0.692***
	(0.184)	(0.146)	(0.147)
Log of GDP (constant 2010 US$)			0.106**
			(0.047)
Constant	1.010***	0.545***	-2.479*
	(0.054)	(0.028)	(1.335)
Country Fixed Effects	YES	NO	NO
Billionaire Fixed effects	NO	YES	YES
Year Fixed Effects	YES	YES	YES
Number of observations	14,431	14,431	14,431
R2	0.072	0.288	0.290
Adjusted R2	0.066	0.287	0.289

note: *** p<0.01, ** p<0.05, * p<0.1, Robust Standard Errors Clustered at the Billionaire level

Table 4: Disaggregated Resource Rents and Billionaire Net Worth

Model	**Country and Year Fixed Effects**	**Billionaire and Year Fixed Effects**	**Billionaire and Year Fixed Effects**
Dependent Variable	**Log of Billionaire Net Worth (in Billions)**		
	(1)	**(2)**	**(3)**
Oil and Natural Gas Rents (% of GDP)	0.011***	0.014***	0.012***
	(0.004)	(0.003)	(0.003)
Mineral and Coal Rents (% of GDP)	0.024**	0.026**	0.028***
	(0.009)	(0.010)	(0.010)
Forest rents (% of GDP)	-0.117**	-0.297***	-0.285***
	(0.059)	(0.058)	(0.058)
Log of GDP (constant 2010 US$)			0.089*
			(0.046)
Constant	0.752***	0.494***	-2.046
	(0.088)	(0.032)	(1.322)
Country Fixed Effects	YES	NO	NO
Billionaire Fixed effects	NO	YES	YES
Year Fixed Effects	YES	YES	YES
Number of observations	18,351	18,351	18,351
R2	0.066	0.281	0.282
Adjusted R2	0.061	0.280	0.282

note: *** p<0.01, ** p<0.05, * p<0.1, Robust Standard Errors Clustered at the Billionaire level

Table 5: Economic Growth and Billionaire Net Worth using Disaggregate Price Shocks as Instruments

Outcome Variable	**Billionaire Net Worth**			
Model	**IV Country and Year FE**		**IV Billionaire and Year FE**	
	Second Stage	**First Stage**	**Second Stage**	**First Stage**
Outcome Variable	**Billionaire Net Worth**	**Log difference GDP**	**Billionaire Net Worth**	**Log difference GDP**
	(3)	**(4)**	**(1)**	**(2)**
Log difference GDP	3.282***		4.088***	
	(0.944)		(0.837)	
Log Difference of Hydrocarbons Commodity Index		0.052***		0.054***
		(0.004)		(0.005)
Log Difference of Metals and Minerals Commodity Index		-0.041***		-0.045***
		(0.013)		(0.013)
Log Difference of Agriculture, Food, and Beverages Commodity Index		-0.176***		-0.161***
		(0.019)		(0.020)
Underidentification test (p-value)	0.000		0.000	
Weak identification test (F stat)	76.063		62.295	
Stock-Yogo weak ID test critical values:				
5% maximal IV relative bias	13.910		13.910	
10% maximal IV relative bias	9.080		9.080	
20% maximal IV relative bias	6.460		6.460	
30% maximal IV relative bias	5.390		5.390	
10% maximal IV size	22.300		22.300	
15% maximal IV size	12.830		12.830	
20% maximal IV size	9.540		9.540	
25% maximal IV size	7.800		7.800	
Hansen J statistic (overidentification test, p-value)	0.040		0.253	
Billionaire Fixed Effects	NO	NO	YES	YES
Country Fixed Effects	YES	YES	NO	NO
Year Fixed Effects	YES	YES	YES	YES
Number of observations	14,431	14,431	13,835	13,835

note: *** p<0.01, ** p<0.05, * p<0.1, robust standard errors clustered at the billionaire level

Table 6: Interaction with Institutions

Model	**Billionaire and Year Fixed Effects**					
Dependent Variable	**Log of Billionaire Net Worth (in Billions)**					
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Log Difference of Commodity Net Export Price Index x WEF Local Competition (0717)	-0.758**					
	(0.361)					
Log Difference of Commodity Net Export Price Index x WEF Market Dominance (0717)		-0.488*				
		(0.253)				
Log Difference of Commodity Net Export Price Index x WGI Control of Corruption (0118)			-0.326**			
			(0.153)			
Total natural resources rents x WEF Local Competition (0717)				-0.018***		
				(0.005)		
Total natural resources rents x WEF Market Dominance (0717)					-0.023***	
					(0.005)	
Total natural resources rents x WGI Control of Corruption (01-18)						-0.009*
						(0.005)
Log difference of commodity Net Export Price Index (historic rolling weights)	4.224**	2.367**	0.387***			
	(1.855)	(1.041)	(0.144)			
Total natural resources rents (% of GDP)				0.102***	0.108***	0.011***
				(0.028)	(0.022)	(0.003)
Log of GDP (constant 2010 US$)	0.145***	0.144***	0.144***	0.098**	0.104**	0.100**
	(0.053)	(0.053)	(0.053)	(0.049)	(0.050)	(0.048)
Constant	-3.672**	-3.663**	-3.666**	-2.333*	-2.506*	-2.401*
	(1.525)	(1.524)	(1.523)	(1.408)	(1.430)	(1.365)
Billionaire Fixed Effects	YES	YES	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES	YES	YES
Number of observations	20,493	20,493	20,502	18,342	18,342	18,351
R2	0.290	0.290	0.290	0.280	0.282	0.278
Adjusted R2	0.289	0.289	0.289	0.279	0.281	0.278

note: *** p<0.01, ** p<0.05, * p<0.1, Robust Standard Errors Clustered at the Billionaire level

Table 7: Commodity Price Shocks, Resource Rents and Tax Revenue Interactions

Model	**Billionaire and Year Fixed Effects**					
Dependent Variable	**Log of Billionaire Net Worth (in Billions)**					
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Log Difference of Commodity Net Export Price Index x Tax revenues (including social contributions and resource taxes) (01-18)	0.016					
	(0.011)					
Log Difference of Commodity Net Export Price Index x Resource Taxes over GDP (01-18)		0.018				
		(0.052)				
Log Difference of Commodity Net Export Price Index x Indirect over Direct Taxes			0.030			
			(0.020)			
Total natural resources rents x Tax revenues (including social contributions) (01-18)				0.0001		
				(0.000)		
Total natural resources rents x Resource Taxes over GDP (01-18)					0.0005	
					(0.001)	
Total natural resources rents x Indirect over Direct Taxes (01-18)						0.0003*
						(0.000)
Log difference of commodity Net Export Price Index (historic rolling weights)	0.135	0.453***	0.164			
	(0.206)	(0.166)	(0.174)			
Total natural resources rents (% of GDP)				0.011***	0.013***	0.011***
				(0.003)	(0.003)	(0.003)
Log of GDP (constant 2010 US$)	0.147***	0.142***	0.135**	0.099**	0.090*	0.104*
	(0.054)	(0.053)	(0.056)	(0.048)	(0.047)	(0.060)
Constant	-3.743**	-3.601**	-3.392**	-2.363*	-2.129	-2.481
	(1.536)	(1.528)	(1.614)	(1.375)	(1.357)	(1.713)
Billionaire Fixed Effects	YES	YES	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES	YES	YES
Number of observations	20,426	19,980	19,183	18,281	17,899	17,152
R2	0.291	0.287	0.295	0.279	0.275	0.281
Adjusted R2	0.291	0.286	0.294	0.278	0.274	0.280

note: *** p<0.01, ** p<0.05, * p<0.1, Robust Standard Errors Clustered at the Billionaire level

Table 8: Effect of Commodity Price Shocks on Tax Revenues

Model	**Country and Year Fixed Effects**		
Outcome (over GDP)	**Tax revenues including social contributions excluding resource revenues**		
	(1)	**(2)**	**(3)**
Log difference of commodity Net Export Price Index (historic rolling weights)	-5.220***		
	(1.450)		
Log Difference of Hydrocarbons Commodity Index		-0.345*	
		(0.194)	
Log Difference of Metals and Minerals Commodity Index		-0.500	
		(0.321)	
Log Difference of Agriculture, Food, and Beverages Commodity Index		-0.748*	
		(0.442)	
Log Difference of Crude oil Commodity Price Index			-0.255
			(0.177)
Log Difference of Coal and Natural Gas Commodity Index			-6.160**
			(2.411)
Log Difference of Base Metals Commodity Index			-0.851***
			(0.307)
Log Difference of Agricultural Raw Materials Commodity Index			-0.440
			(2.742)
Log Difference of Food Commodity Index			-0.805*
			(0.474)
Log Difference of Beverages Commodity Index			-0.406
			(1.387)
Log Difference of Fertilizer Commodity Index			0.839
			(0.612)
Log Difference of Precious Metals Commodity Index			9.863*
			(5.210)
Constant	17.214***	18.805***	18.810***
	(0.496)	(0.541)	(0.543)
Country Fixed Effects	YES	YES	YES
Year Fixed Effects	YES	YES	YES
Number of observations	4,766	3,439	3,439
R2	0.106	0.130	0.132
Adjusted R2	0.099	0.120	0.121

note: *** p<0.01, ** p<0.05, * p<0.1, robust standard errors clustered at the country level

APPENDIX

Table A1: Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Billionaire Analysis					
Log of Billionaire Net Worth (in Billions)	20,512	0.91	0.76	0.00	4.72
Log difference of Commodity Net Export Price Index (historic rolling weights)	20,512	0.0002	0.020	-0.357	0.164
Log Difference of Agricultural Raw Materials Commodity Index	14,424	0.00004	0.004	-0.097	0.072
Log Difference of Base Metals Commodity Index	14,424	-0.0001	0.021	-0.424	0.587
Log Difference of Beverages Commodity Index	14,424	-0.0002	0.004	-0.048	0.071
Log Difference of Coal and Natural Gas Commodity Index	14,424	0.0001	0.010	-0.148	0.110
Log Difference of Fertilizer Commodity Index	14,424	-0.00002	0.005	-0.047	0.038
Log Difference of Food Commodity Index	14,424	0.0008	0.020	-0.171	0.360
Log Difference of Precious Metals Commodity Index	14,424	0.0000	0.005	-0.170	0.169
Log Difference of Crude oil Commodity Price Index	14,424	0.0018	0.061	-0.862	0.692
Total natural resources rents (% of GDP)	18,339	2.981	6.193	0.000	62.047
Oil and Natural Gas Rents (% of GDP)	18,339	2.019	5.804	0.000	62.047
Mineral and Coal Rents (% of GDP)	18,339	0.833	1.610	0.000	20.921
Forest rents (% of GDP)	18,339	0.129	0.328	0.000	12.548
Log of GDP (constant 2010 US$)	20,502	28.839	1.532	20.469	30.513
WEF Intensity of local competition (1-7 Best) (2007-2018)	20,503	5.585	0.435	3.112	6.085
WEF Extent of market dominance (1-7 Best) (2007-2018)	20,503	4.825	0.725	2.312	5.879
WGI Control of Corruption (0118)	20,512	0.894	0.982	-1.330	2.344
Manufacturing, value added (% of GDP)	19,635	15.214	6.588	1.025	64.719
Agriculture, forestry, and fishing, value added (% of GDP)	19,651	3.375	4.104	0.025	31.535
Log of GDP (constant 2010 US$)	20,502	28.839	1.532	20.469	30.513
Tax Analysis					
Tax revenues including social contributions excluding resource revenues	4,513	19.311	11.091	0.000	56.916
Resource tax revenues	4,915	0.729	2.925	-0.725	39.167
Direct taxes including social contributions, excluding resource revenue	3,943	10.021	8.740	0.000	38.138
Taxes on income, profits, and capital gains (excluding resource component)	4,056	5.973	4.341	0.000	24.211
Corporations and other enterprises (excluding resource component)	3,230	2.264	1.601	0.000	32.841
Indirect Tax (excluding resource component)	4,237	9.993	4.361	0.017	45.403
General Taxes on goods and services	3,381	5.283	3.196	0.000	18.938
VAT	2,601	4.976	3.017	0.000	18.886
Taxes on international trade and transactions	4,194	2.470	2.957	-1.569	38.159
Import Tax	3,451	1.919	2.405	-0.014	26.242
Export Tax	3,128	0.130	0.458	-2.140	6.050
Social contributions (% of revenue)	2,273	18.046	14.393	-0.188	60.008

Table A2: Disaggregated Commodity Price Shocks (8 categories) and Billionaire Net Worth

Model	**Country and Year Fixed Effects**	**Billionaire and Year Fixed Effects**	
Dependent Variable	**Log of Billionaire Net Worth (in Billions)**		
	(1)	**(2)**	**(3)**
Log Difference of Crude oil Commodity Price Index	0.263***	0.222***	0.224***
	(0.093)	(0.073)	(0.073)
Log Difference of Coal and Natural Gas Commodity Index	-0.317	0.478	0.465
	(0.387)	(0.351)	(0.351)
Log Difference of Base Metals Commodity Index	0.333	0.130	0.119
	(0.238)	(0.160)	(0.157)
Log Difference of Agricultural Raw Materials Commodity Index	-0.756	-2.652***	-2.636***
	(0.876)	(0.653)	(0.653)
Log Difference of Food Commodity Index	-0.490**	-0.592***	-0.575***
	(0.203)	(0.154)	(0.155)
Log Difference of Beverages Commodity Index	-1.780	-0.806	-1.053
	(1.165)	(0.934)	(0.946)
Log Difference of Fertilizer Commodity Index	0.309	-0.916	-1.052
	(0.907)	(0.847)	(0.849)
Log Difference of Precious Metals Commodity Index	1.140**	-0.035	-0.027
	(0.581)	(0.271)	(0.268)
Log of GDP (constant 2010 US$)			0.107**
			(0.047)
Constant	1.035***	0.545***	-2.526*
	(0.060)	(0.028)	(1.348)
Country Fixed Effects	YES	NO	NO
Billionaire Fixed effects	NO	YES	YES
Year Fixed Effects	YES	YES	YES
Number of observations	14,431	14,431	14,431
R2	0.072	0.289	0.290
Adjusted R2	0.066	0.287	0.289

note: *** p<0.01, ** p<0.05, * p<0.1, Robust Standard Errors Clustered at the Billionaire level

Table A3: Commodity Price Shocks and Billionaire Net Worth with Control for Sectoral Composition of Economy

Model	Country and Year Fixed Effects	Billionaire and Year Fixed Effects	Billionaire and Year Fixed Effects
Dependent Variable	**Log of Billionaire Net Worth (in Billions)**		
	(1)	**(2)**	**(3)**
Log difference of commodity Net Export Price Index (historic rolling weights)	0.637***	0.319**	0.327**
	(0.190)	(0.146)	(0.147)
Manufacturing, value added (% of GDP)	0.004	-0.017***	-0.020***
	(0.007)	(0.006)	(0.006)
Agriculture, forestry, and fishing, value added (% of GDP)	-0.014	-0.070***	-0.063***
	(0.014)	(0.012)	(0.011)
Log of GDP (constant 2010 US$)			0.127**
			(0.052)
Constant	1.046***	1.027***	-2.589*
	(0.140)	(0.120)	(1.466)
Country Fixed Effects	YES	NO	NO
Billionaire Fixed effects	NO	YES	YES
Year Fixed Effects	YES	YES	YES
Number of observations	19,635	19,635	19,635
R2	0.065	0.287	0.289
Adjusted R2	0.060	0.286	0.288

note: *** p<0.01, ** p<0.05, * p<0.1, Robust Standard Errors Clustered at the Billionaire level

Table A4: Natural Resource Rents and Billionaire Net Worth with Control for Economy Sectoral Composition

Model	Country and Year Fixed Effects	Billionaire and Year Fixed Effects	Billionaire and Year Fixed Effects
Dependent Variable	**Log of Billionaire Net Worth (in Billions)**		
	(1)	**(2)**	**(3)**
Total natural resources rents (% of GDP)	0.013***	0.015***	0.014***
	(0.004)	(0.003)	(0.003)
Manufacturing, value added (% of GDP)	0.003	-0.017***	-0.019***
	(0.007)	(0.006)	(0.006)
Agriculture, forestry, and fishing, value added (% of GDP)	-0.011	-0.069***	-0.065***
	(0.015)	(0.013)	(0.012)
Log of GDP (constant 2010 US$)			0.081
			(0.051)
Constant	0.745***	1.000***	-1.279
	(0.165)	(0.117)	(1.425)
Country Fixed Effects	YES	NO	NO
Billionaire Fixed effects	NO	YES	YES
Year Fixed Effects	YES	YES	YES
Number of observations	18,257	18,257	18,257
R2	0.066	0.287	0.287
Adjusted R2	0.061	0.286	0.287

note: *** p<0.01, ** p<0.05, * p<0.1, Robust Standard Errors Clustered at the Billionaire level

Table A5 Price Shocks and Sector Fixed Effects

Model	**Billionaire and Year Fixed Effects**			
Dependent Variable	**Log of Final Worth in Billions**			
	(1)	**(2)**	**(3)**	**(4)**
Log difference of commodity Net Export Price Index (historic rolling weights)	0.603***	0.385***	0.592***	0.336**
	(0.188)	(0.147)	(0.201)	(0.152)
6 Category Sector Fixed Effects (Others sector omitted)				
IT	0.206***	-0.010		
	(0.078)	(0.055)		
Agriculture	-0.023	-0.250**		
	(0.090)	(0.109)		
Extractives	0.145***	-0.020		
	(0.054)	(0.062)		
Manufacturing	-0.009	-0.011		
	(0.040)	(0.043)		
Services	-0.0001	0.014		
	(0.034)	(0.031)		
57 Category Sector FE (Agriculture omitted omitted)				
Apparel			0.030	0.160
			(0.147)	(0.144)
Automotive			0.101	0.480***
			(0.142)	(0.138)
Aviation			-0.192	0.191
			(0.183)	(0.116)
Banks			0.148	0.103
			(0.193)	(0.114)
Beverages			0.089	0.158
			(0.148)	(0.212)
Biotechnology			1.260***	0.583***
			(0.138)	(0.176)
Business			0.912*	0.588**
			(0.475)	(0.269)
Casinos & Gaming			0.033	0.064
			(0.233)	(0.290)
Chemicals			-0.092	0.474
			(0.168)	(0.321)
Coal			-0.092	0.725***
			(0.093)	(0.137)
Construction & Engineering			0.007	0.183
			(0.107)	(0.158)
Consumer Products			1.082***	0.569*

	(0.212)	(0.293)
Consumer Services	-0.245*	0.490***
	(0.132)	(0.160)
Cruise Line	0.311***	-0.174
	(0.089)	(0.116)
Diversified	0.208**	0.327***
	(0.105)	(0.126)
Electronics	-0.087	0.260
	(0.231)	(0.168)
Energy	0.192*	0.323**
	(0.113)	(0.138)
Entertainment	-0.722***	0.385**
	(0.092)	(0.157)
Fashion and Retail	0.217**	0.298**
	(0.107)	(0.125)
Finance	-0.134	0.292**
	(0.097)	(0.122)
Finance and Investments	0.028	0.284**
	(0.098)	(0.120)
Food	-0.087	0.247**
	(0.136)	(0.109)
Food and Beverage	0.105	0.257**
	(0.105)	(0.104)
Gambling & Casinos	0.250	0.211
	(0.182)	(0.202)
Gaming	0.219	0.192
	(0.207)	(0.230)
Healthcare	-0.064	0.384**
	(0.097)	(0.183)
Hotels & Resorts	-0.139	0.308
	(0.256)	(0.223)
Information Technology	-0.203	-0.106
	(0.223)	(0.334)
Insurance	-0.151	0.537***
	(0.124)	(0.167)
Internet	0.088	-0.267
	(0.183)	(0.215)
Internet Content-Entertainment	-0.682***	
	(0.118)	
Investments	0.031	0.300**
	(0.106)	(0.119)
Leisure	0.104	0.428*
	(0.294)	(0.232)

Logistics	0.008	0.518***
	(0.128)	(0.165)
Luxury Goods	1.349***	0.069
	(0.302)	(0.141)
Manufacturing	0.025	0.267**
	(0.097)	(0.119)
Media	0.035	0.384***
	(0.111)	(0.130)
Media & Entertainment	0.199*	0.317**
	(0.119)	(0.132)
Medicine	-0.251	0.356*
	(0.216)	(0.190)
Metals & Mining	0.402***	0.247
	(0.137)	(0.193)
Mineral	-0.357***	
	(0.095)	
Oil	-0.049	0.174
	(0.105)	(0.148)
Pharmaceuticals	0.286*	0.380**
	(0.152)	(0.179)
Philanthropy/NGO	1.917***	0.506***
	(0.093)	(0.132)
Politics	0.724	0.401**
	(0.553)	(0.184)
Real Estate	0.082	0.261*
	(0.098)	(0.154)
Retail	0.204	0.321***
	(0.124)	(0.123)
Semiconductors	-0.185	0.237*
	(0.196)	(0.136)
Service	-0.080	0.202*
	(0.105)	(0.119)
Shipping	-0.167	0.341**
	(0.116)	(0.163)
Software	0.669**	0.216
	(0.300)	(0.153)
Sports	-0.240**	0.382***
	(0.121)	(0.139)
Steel	0.376	0.266
	(0.292)	(0.291)
Technology	0.237**	0.241*
	(0.117)	(0.132)
Telecommunications	0.346*	0.519***

			(0.194)	(0.201)
Transportation			-0.460***	0.543***
			(0.119)	(0.159)
Constant	0.906***	0.468***	0.961***	0.203*
	(0.041)	(0.034)	(0.099)	(0.114)
Sector (6 Categories) Fixed Effects	YES	YES	NO	NO
Sector (57 Categories) Fixed Effects	NO	NO	YES	YES
Country Fixed Effects	YES	NO	YES	NO
Billionaire Fixed effects	NO	YES	NO	YES
Number of observations	20,512	20,512	19,437	19,437
R2	0.071	0.286	0.094	0.289
Adjusted R2	0.067	0.285	0.087	0.286

note: *** p<0.01, ** p<0.05, * p<0.1, Robust Standard Errors Clustered at the Billionaire level

Table A6 Resource Rents and Sector Fixed Effects

Model	**Billionaire and Year Fixed Effects**			
Dependent Variable	**Log of Final Worth in Billions**			
	(1)	**(2)**	**(3)**	**(4)**
Total natural resources rents (% of GDP)	0.012***	0.014***	0.011***	0.013***
	(0.004)	(0.003)	(0.004)	(0.003)
6 Category Sector Fixed Effects (Others sector omitted)				
IT	0.217***	-0.020		
	(0.083)	(0.053)		
Agriculture	-0.023	-0.245**		
	(0.090)	(0.101)		
Extractives	0.153***	0.007		
	(0.054)	(0.060)		
Manufacturing	-0.003	-0.007		
	(0.041)	(0.041)		
Services	0.008	0.015		
	(0.035)	(0.030)		
57 Category Sector Fixed Effects (Agriculture omitted omitted)				
Apparel			0.041	0.166
			(0.148)	(0.136)
Automotive			0.113	0.474***
			(0.148)	(0.127)
Aviation			-0.171	0.190*
			(0.183)	(0.109)
Banks			0.114	0.070
			(0.203)	(0.111)

Beverages	0.079	0.134
	(0.148)	(0.196)
Biotechnology	1.269***	0.581***
	(0.144)	(0.163)
Business	0.922*	0.580**
	(0.476)	(0.256)
Casinos & Gaming	0.044	0.062
	(0.232)	(0.284)
Chemicals	-0.089	0.497
	(0.166)	(0.312)
Coal	-0.131	0.733***
	(0.095)	(0.128)
Construction & Engineering	0.002	0.217
	(0.107)	(0.149)
Consumer Products	1.085***	0.523**
	(0.216)	(0.258)
Consumer Services	-0.226*	0.490***
	(0.133)	(0.153)
Cruise Line	0.331***	-0.153
	(0.089)	(0.110)
Diversified	0.217**	0.325***
	(0.107)	(0.117)
Electronics	-0.081	0.255
	(0.232)	(0.156)
Energy	0.204*	0.351***
	(0.113)	(0.129)
Entertainment	-0.702***	0.360**
	(0.093)	(0.159)
Fashion and Retail	0.232**	0.299**
	(0.109)	(0.117)
Finance	-0.127	0.293***
	(0.097)	(0.113)
Finance and Investments	0.034	0.287***
	(0.099)	(0.111)
Food	-0.078	0.235**
	(0.137)	(0.102)
Food and Beverage	0.100	0.244**
	(0.106)	(0.097)
Gambling & Casinos	0.243	0.199
	(0.189)	(0.196)
Gaming	0.231	0.233
	(0.206)	(0.232)
Healthcare	-0.063	0.408**

	(0.099)	(0.170)
Hotels & Resorts	-0.138	0.323
	(0.242)	(0.226)
Information Technology	-0.183	-0.080
	(0.224)	(0.320)
Insurance	-0.140	0.541***
	(0.124)	(0.156)
Internet	0.094	-0.224
	(0.185)	(0.203)
Internet Content-Entertainment	-0.664***	
	(0.122)	
Investments	0.043	0.300***
	(0.106)	(0.110)
Leisure	0.118	0.412**
	(0.293)	(0.206)
Logistics	0.013	0.518***
	(0.130)	(0.156)
Luxury Goods	1.373***	0.120
	(0.305)	(0.133)
Manufacturing	0.037	0.287***
	(0.098)	(0.110)
Media	0.045	0.372***
	(0.111)	(0.122)
Media & Entertainment	0.213*	0.320***
	(0.120)	(0.123)
Medicine	-0.242	0.370**
	(0.215)	(0.176)
Metals & Mining	0.427***	0.299
	(0.138)	(0.187)
Mineral	-0.378***	
	(0.096)	
Oil	-0.047	0.177
	(0.105)	(0.138)
Pharmaceuticals	0.290*	0.400**
	(0.152)	(0.167)
Philanthropy/NGO	1.913***	0.499***
	(0.093)	(0.123)
Politics	0.713	0.405**
	(0.565)	(0.192)
Real Estate	0.083	0.264*
	(0.099)	(0.145)
Retail	0.211*	0.323***
	(0.124)	(0.115)

Semiconductors			-0.164	0.264**
			(0.196)	(0.127)
Service			-0.087	0.205*
			(0.106)	(0.112)
Shipping			-0.163	0.338**
			(0.116)	(0.156)
Software			0.678**	0.232
			(0.301)	(0.143)
Sports			-0.262**	0.346***
			(0.124)	(0.130)
Steel			0.354	0.274
			(0.292)	(0.285)
Technology			0.241**	0.236*
			(0.120)	(0.122)
Telecommunications			0.359*	0.495***
			(0.198)	(0.186)
Transportation			-0.440***	0.542***
			(0.119)	(0.151)
Constant	0.690***	0.449***	0.767***	0.185*
	(0.087)	(0.034)	(0.129)	(0.106)
Sector (6 Categories) Fixed Effects	YES	YES	NO	NO
Sector (57 Categories) Fixed Effects	NO	NO	YES	YES
Country Fixed Effects	YES	NO	YES	NO
Billionaire Fixed effects	NO	YES	NO	YES
Year Fixed Effects	YES	YES	YES	YES
Number of observations	18,382	18,382	17,307	17,307
R2	0.074	0.277	0.098	0.279
Adjusted R2	0.069	0.276	0.090	0.276

note: *** p<0.01, ** p<0.05, * p<0.1, Robust Standard Errors Clustered at the Billionaire level

Table A7: Sector classification

Agriculture - (0.54%)	**Extractives - (7.28 %)**	**Services - (41.39%)**	**IT - (7.72%)**	**Manufacturing - 17.86%**	**Others - 25.15%**
Agriculture - (0.54 %)	Coal - (0.02 %)	Banks - (0.06 %)	Biotechnology - (0.02 %)	Apparel - (0.68 %)	Construction & Engineering - (2.08 %)
	Energy - (3.44 %)	Business - (0.08 %)	Electronics - (0.27 %)	Automotive - (1.77 %)	Diversified - (5.58 %)
	Metals & Mining - (1.91 %)	Casinos & Gaming - (0.14 %)	Information Technology - (0.06 %)	Aviation - (0.04 %)	Real Estate - (6.36 %)
	Mineral - (0.02 %)	Consumer Services - (0.16 %)	Internet - (0.41 %)	Beverages - (0.51 %)	Politics - (0.06 %)
	Oil - (1.89 %)	Consumer Products - (0.06 %)	Internet Content-Entertainment - (0.02 %)	Chemicals - (0.25 %)	Philanthropy/NGO - (0.02 %)
		Cruise Line - (0.02 %)	Software - (0.58 %)	Food - (1.19 %)	Sports - (0.58 %)
		Entertainment - (0.06 %)	Technology - (5.5 %)	Food and Beverage - (4.92 %)	Transportation - (0.04 %)
		Fashion and Retail - (6.67 %)	Telecommunications - (0.86 %)	Manufacturing - (7.45 %)	Logistics - (1.19 %)
		Finance - (5.62 %)		Medicine - (0.16 %)	Shipping - (0.78 %)
		Finance and Investments - (7.74 %)		Pharmaceuticals - (0.6 %)	Missing - (8.46 %)
		Gambling & Casinos - (0.66 %)		Semiconductors - (0.08 %)	
		Gaming - (0.51 %)		Steel - (0.21 %)	
		Healthcare - (3.85 %)			
		Hotels & Resorts - (0.1 %)			
		Insurance - (0.37 %)			
		Investments - (4.69 %)			
		Leisure - (0.06 %)			
		Luxury Goods - (0.04 %)			
		Media - (3.03 %)			
		Media & Entertainment - (2.14 %)			
		Retail - (3.17 %)			
		Service - (2.16 %)			

Table A8: Resource Rents and Commodity Price Shocks based on Billionaire Residence

Model	**Country and Year Fixed Effects**	**Billionaire and Year Fixed Effects**		**Country and Year Fixed Effects**	**Billionaire and Year Fixed Effects**	
Dependent Variable	**Log of Final Worth in Billions**					
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Log difference of commodity Net Export Price Index based on primary residence (historic rolling weights)	0.639***	0.387***	0.380***			
	(0.186)	(0.148)	(0.146)			
Total natural resources rents (% of GDP) - based on primary residence				0.014***	0.012***	0.012***
				(0.004)	(0.003)	(0.003)
Log of GDP (constant 2010 US$)			0.145***			0.103***
			(0.053)			(0.037)
Constant	0.891***	0.467***	-3.673**	0.642***	0.462***	-2.477**
	(0.031)	(0.030)	(1.526)	(0.079)	(0.030)	(1.070)
Country (Place of Primary Residence) Fixed Effects	YES	NO	NO	YES	NO	NO
Billionaire Fixed Effects	NO	YES	YES	NO	YES	YES
Year Fixed effects	YES	YES	YES	YES	YES	YES
Number of observations	20,249	20,512	20,502	18,107	18,107	18,082
R2	0.062	0.285	0.289	0.062	0.275	0.278
Adjusted R2	0.057	0.284	0.289	0.057	0.274	0.277

note: *** p<0.01, ** p<0.05, * p<0.1, Robust Standard Errors Clustered at the Billionaire level

Table A9: Resource Rents and Tax Revenues

Model	**Country and Year Fixed Effects**	
Outcome (over GDP)	**Tax revenues including social contributions excluding resource revenues**	
	(1)	**(2)**
Total natural resources rents (% of GDP)	-0.101***	
	(0.022)	
Oil and Natural Gas Rents (% of GDP)		-0.133***
		(0.032)
Mineral and Coal Rents (% of GDP)		-0.046
		(0.048)
Forest rents (% of GDP)		-0.008
		(0.108)
Constant	18.264***	18.212***
	(0.544)	(0.530)
Country Fixed Effects	YES	YES
Year Fixed Effects	YES	YES
Number of observations	5,159	5,047
R2	0.126	0.129
Adjusted R2	0.120	0.122

note: *** p<0.01, ** p<0.05, * p<0.1, robust standard errors clustered at the country level

Table A10: Effect of Commodity Price Shocks on Tax Revenue components

Model	**Country and Year Fixed Effects**									
Outcome (over GDP)	**Resource tax revenues**	**Direct taxes including social contributions, excluding resource revenue**	**Taxes on income, profits, and capital gains (excluding resource component)**	**Corporations and other enterprises (excluding resource component)**	**Indirect Tax (excluding resource component)**	**General Taxes on goods and services**	**VAT**	**Taxes on international trade and transactions**	**Import Tax**	**Export Tax**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**
Log difference of commodity Net Export Price Index (historic rolling weights)	4.312	-1.958***	-1.500**	-0.321	-4.486***	-1.201*	-0.280	-1.904***	-1.742**	-0.187
	(4.170)	(0.750)	(0.664)	(0.682)	(0.926)	(0.699)	(0.947)	(0.632)	(0.861)	(0.244)
Constant	0.969***	8.615***	5.410***	1.935***	9.122***	3.541***	2.324***	3.436***	2.634***	0.522***
	(0.170)	(0.402)	(0.275)	(0.175)	(0.349)	(0.247)	(0.535)	(0.202)	(0.176)	(0.117)
Country Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Number of observations	4,915	4,207	4,270	3,415	4,612	3,793	2,937	4,723	3,857	3,522
R2	0.035	0.102	0.063	0.036	0.055	0.282	0.268	0.148	0.172	0.086
Adjusted R2	0.027	0.094	0.055	0.025	0.047	0.274	0.259	0.141	0.164	0.076

note: *** p<0.01, ** p<0.05, * p<0.1, robust standard errors clustered at the country level

Table A11: Effect of Resource Rents on Tax Revenue components

Model	**Country and Year Fixed Effects**									
Outcome (over GDP)	**Resource tax revenues**	**Direct taxes including social contributions, excluding resource revenue**	**Taxes on income, profits, and capital gains (excluding resource component)**	**Corporations and other enterprises (excluding resource component)**	**Indirect Tax (excluding resource component)**	**General Taxes on goods and services**	**VAT**	**Taxes on international trade and transactions**	**Import Tax**	**Export Tax**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**
Total natural resources rents (% of GDP)	0.068*	-0.016	-0.013	0.015	-0.045***	-0.020**	-0.017	-0.032*	-0.001	0.007
	(0.039)	(0.013)	(0.011)	(0.022)	(0.016)	(0.010)	(0.013)	(0.016)	(0.012)	(0.007)
Constant	0.368	8.807***	5.600***	1.810***	9.631***	3.754***	2.590***	3.908***	2.751***	0.472***
	(0.320)	(0.403)	(0.291)	(0.218)	(0.354)	(0.249)	(0.520)	(0.276)	(0.189)	(0.106)
Country Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Number of observations	5,329	4,525	4,630	3,724	4,986	4,099	3,209	5,097	4,139	3,749
R2	0.064	0.104	0.064	0.037	0.062	0.277	0.252	0.144	0.150	0.082
Adjusted R2	0.057	0.096	0.056	0.027	0.055	0.270	0.243	0.138	0.142	0.072

note: *** p<0.01, ** p<0.05, * p<0.1, robust standard errors clustered at the country level

Table A12: Commodity Price Shocks, Resource Rents and Social Contributions

Model	Country and Year Fixed Effects			
Outcome Variable	**Social contributions (% of revenue) - IMF/WDI**			
	(1)	**(2)**	**(3)**	**(4)**
Log difference of commodity Net Export Price Index (historic rolling weights)	-8.467***			
	(2.629)			
Total natural resources rents (% of GDP)			-0.167***	
			(0.058)	
Log Difference of Hydrocarbons Commodity Index		-0.104		
		(0.190)		
Log Difference of Metals and Minerals Commodity Index		-1.117*		
		(0.627)		
Log Difference of Agriculture, Food, and Beverages Commodity Index		-1.584		
		(1.148)		
Oil and Natural Gas Rents (% of GDP)				-0.201**
				(0.086)
Mineral and Coal Rents (% of GDP)				-0.100**
				(0.051)
Forest rents (% of GDP)				-0.174
				(0.141)
Constant	15.467***	17.305***	16.889***	16.888***
	(1.013)	(1.092)	(0.992)	(1.002)
Country Fixed Effects	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES
Number of observations	2,304	1,950	2,424	2,409
R2	0.081	0.057	0.075	0.075
Adjusted R2	0.066	0.039	0.060	0.059

note: *** p<0.01, ** p<0.05, * p<0.1, Robust standard errors reported clustered at the country level