Oil Price Volatility, Financial Institutions and Economic Growth*

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December 2016

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*Prepared for the 23rd Annual Conference of the Economic Research Forum, Jordan March, 2017.

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1. Introduction

A number of studies indicate that the effect of natural resources on income depends on the quality of institutions (e.g., Lane and Tornell (1996); Mehlum, Moene, and Torvik 2006; Robinson, J. A., R. Torvik, and T. Verdier, 2006; Boschini, Pettersson and Roine, 2007). Given recent doubts about the adverse *level* effects of resource abundance on income (e.g., Alexeev, M., & Conrad, R. 2009), some studies have focused on the *volatility* of resource wealth instead. For example, Leong and Mohaddes (2011) and El-Anshasy et al. (2015) have shown that resource rent volatility negatively affects economic growth and as such, is the reason for the resource curse as opposed to just share abundance of resources. But here again, the intermediating role of institutions arises. For example, using the Fraser chain-linked index of institutional quality, Leong and Mohaddes (2011) show that the resource volatility seems to be moderated with higher quality institutions.[1]

Why should institutions moderate the effect of oil rent volatility on growth? The answer must lie in the specific *mechanisms* by which this happens. A closely related question is what types of institutions are likely to dampen such an effect? Economic theory suggests that the most relevant and key institutions that mitigate the effects of volatility on an economy are the institutions of finance. This is due to the well-known role of finance in risk diversification (see, for example, Levine 1997). To see if financial institutions are relevant to begin with, an initial investigation into the sub-components of the Fraser chain-linked index in carried out, showing very high positive correlation of the financial components with the overall Fraser Chain Linked Index, while also showing a negative correlation of other indicators with the overall Index (see table 1). The high correlation of the overall index with the financial measures is the first piece of evidence that suggests that the observed mitigation of oil volatility found in Leong and Mohaddes (2011) may be driven by financial depth.

Our first contribution is therefore to shed light on the question of whether the institutions of finance play a role in moderating the effect of resource volatility on income or growth as theory suggests. In an

[1] A number of studies, notably Egorov, et. al. (2009), Ross (2011), Williams (2011) and Mohtadi, Ross and Rudiger (2014) and Mohtadi, Ross, Rudiger and Jarrett (2016) show that institutions especially transparency, are themselves affected by oil wealth. To the extent that our focus here is the *volatility* and *not* the level of oil wealth, this issue should not pose estimation difficulties.

attempt to shed light on this question we focus on specific components of the Fraser chain-linked index related to the quality of financial institutions.

Table 1: Correlation coefficients of some components of the Fraser chain link index

Sub components	Correlation with overall index
Financial Measures	
Ownership of Banks	0.9313
Private Sector Credit	0.7819
Interest Rate Controls	0.9597
Credit Market Regulations	0.9864
Non-Financial Measures	
Hiring and Firing regulations	-0.4196
Gov. consumption	-0.5598
Transfers and subsidies	-0.3308
Judicial independence	-0.8283
Military interference in rule of law	-0.5156
Business costs of crime	0.1154

The second contribution of this paper is to take into account the *enhanced* ability of financial institutions to diversify risk when they are internationally integrated. The theoretical basis for this is that internationally integrated capital markets allow for consumption smoothing through international risk diversification (see for example Obstfeld's 1996 classic work). In practice, the effect is more nuanced and once again depends on the quality of institutions (Boileau and Zheng, 2015, and Zheng, 2015) as well as the type and direction of international capital flows (Fan, Mohtadi and Neumann, 2016). We will therefore incorporate the two well-known measures of international capital market integration, the Lane-Milesi-Ferretti (1997) and the Chin-Ito (2006) index, into our measure of financial institutions as the additional conditioning variables, to examine their role in the impact of oil rent volatility on economic growth.

Our Third Contribution is to examine the effect of dramatic drop, and consequent volatility in oil prices since 2014 on oil producers. Our goal is to highlight the effect of differences in financial depth across oil rich countries on their ability to deal with oil price volatility, particularly with respect to the recent decline of oil prices starting in the first quarter of 2014.

We use two distinct methodologies; to answer the first two questions, we use a panel autoregressive distributed lag (ARDL) approach to investigate the relationship between economy wide growth, oil price growth and volatility and financial depth. To answer the third question, we develop a counterfactual approach based on a novel technique of creating *synthetic controls* originally pioneered by Abadie and Gardeazabal (2003).

2. Data

We use two datasets for this paper: an annual data set comprised of 194 countries between 1980 and 2014 is used to investigate the impact of local financial development and openness measures on mitigating oil volatility. For the counterfactual analysis, we use a quarterly dataset of 44 countries between the first quarter of 2006 and the fourth quarter of 2015 to investigate the impact of higher volatility in oil prices post 2014. Switching to a quarterly dataset gives us more post treatment data points to track any potential difference between those with low and high financial depth measures[2].

3. Methodology and Results

We first present the panel autoregressive distributed lag (ARDL) estimation to be followed by the Synthetic counterfactual estimation

3.1 Autoregressive distributed lag (ARDL) Model

The use of ARDL with dynamic fixed effects allows us to take advantage of the co-integration between the variables of interest over time. In an analysis such as this where institutional variables are involved, a high degree of persistence in the *level* of these measures is to be expected rendering analyses that depend on taking a first difference or demeaning less than appropriate[3]. An alternative would be to take five year averages as is commonly done, but doing so eliminates some variation in other variables of interest such as oil price growth and oil volatility. The ARDL approach allows us to study the long run effects of these persistent institutional variables in conjunction with the more erratic oil price growth using annual data[4]. It also enables us to simultaneously account for the problem of reverse causality and

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[2] Appendix 1 details the data as well as definitions and source

[3] The short run results generated by the ARDL estimation process are also subject to this consequence and as such, are ignored in this analysis.

[4] This is a unique feature of the ARDL models: the ability to handle both I(1) and I(0) variables simultaneously.

deal with potentially endogenous variables without losing a significant amount of data points. As a result, we estimate the following equation using the dynamic fixed effects approach[5]

$$\Delta Growth_{i,t} = \emptyset\left(Growth_{i,t-1} - \theta_0 - \theta_1 Oil\_gro_{\boldsymbol{i,t}} + \theta_2 OilVol_{\boldsymbol{i,t}} - \boldsymbol{\theta_3 X'_{i,t}}\right) + \delta_1 \Delta Oil\_gro_{\boldsymbol{i,t}} + \delta_2 \Delta OilVol_{\boldsymbol{i,t}} - \boldsymbol{\delta_3} \Delta \boldsymbol{X'_{i,t}}$$

Where,

$Growth_{i,t}$ is the growth rate of country *i* at time *t*

∅ is the short run error correction coefficient

θ_i are the long run coefficients of the ith variable

δ_i are the short run coefficients

Oil_gro is the change in the annual average oil price

OilVol is the standard deviation of monthly oil prices for each year

X is a vector of control variables

3.1.1 Results

Results are reported in tables 2-4. As indicated, a list of variables is given in Appendix 1. Table 2 is a benchmark table and is aimed at proof of concept. With growth as the dependent variable and the estimation methodology as ARDL dynamic fixed effects, the report stresses long run effects as the short run should not matter in this context. Column 1 is the standard growth empirical model, where growth is determined by lag level of GDP, capital stock, population (pop) and secondary school education. Column 2 introduces oil growth effects, and column 3 captures both oil growth and oil volatility. Columns 4 and 5 introduce the composite Fraser chain linked index and the interaction of this index and oil volatility respectively. The introduction of these measures eliminate the significance of oil volatility on growth which corroborates the findings of Leong and Mohaddes (2011). Columns 6 to 11 show the effect of the components of the Fraser chain index that *a priori* we do not believe should have a mitigating effect on the growth impact of volatility and in some cases are in fact negatively correlated with the overall Fraser Chain Index measure. Indeed, with the exception of impartial courts, these variables do not perform well. Impartial courts matter probably because they reduce contract uncertainties in financial and property rights transactions and therefore are indirectly relevant.

[5] See Blackburne and Frank (2007) for more on this model as well as the stata command that implements this estimation method.

Table 3 reports the role of financial variables. Column 1 replicates the standard empirical model with oil growth and volatility. Columns 2 through 9 introduce the different local financial measures we believe have an impact on mitigating volatility: These are the variables that were positively correlated with the overall Fraser chain index measure. Most perform well, as the introduction of each variable weakens the significance of oil volatility and the interaction term eliminates it. An exception is Column 9 where the variable is credit market regulations. Here, interaction between credit market regulations and oil volatility is both significant and *reverses* the effect of oil volatility itself on growth. Could this be a result of financial policies adjusting to compensate for fluctuating oil prices? It is hard to say. The next section on synthetic controls should shed further lights on these questions.

Table 4 focuses on the role of international financial and trade openness in mitigating the oil volatility effects. Column 1 replicates the standard empirical model with oil growth and volatility. Columns 2 through 7 introduce different openness measures and the interaction between these measures and oil volatility. We see that trade openness has a negative effect on growth but helps mitigate the effect of oil volatility (positive coefficient of the interaction term) but does not eliminate the negative effects of volatility. The de facto financial measure (DF) contributes to overall growth but eliminates the positive effect of oil growth on growth rates while doing nothing to mitigate oil volatility. The de jure measure of financial openness (DJ) also eliminates the positive effect of oil growth but eliminates the negative effect of oil volatility. All in all, risk sharing at the international level does not seem to reduce the volatility effects of oil on income. Perhaps heavy oil producers are more prone to import substitutions and thus, less open in both trade and capital markets.

It is with these reservations that we now embark on the next methodological treatment of the question, namely synthetic controls.

3.2 The synthetic control Method

The counterfactual approach employs the methodology pioneered by Abadie and Gardeazabal (2003) hence forth known as AG. It is a variation of the difference in difference approach, but instead of the traditional control group being determined by pre intervention propensity matching, a *synthetic control* is developed by constructing a weighted average of potential controls to get the "best fit" that closely matches the treated unit's pretreatment variables. AG use this methodology to study the Basque region of Spain to show that terrorist activities in the region post 1960 reduced GDP per capita by about 10 percentage points when compared to a synthetic control (composed of different areas in Spain similar to the Basque region but unaffected by the terrorist activities) in the same time period. Another important appropriation of this methodology with regard to what we intend to do, was carried out in Singhal and Nilakantan (2016), henceforth SN. SN use this approach to study the effect of the development of a specially trained task force designed to combat this insurgency in the Andhra Pradesh region and not the impact of the Naxalite insurgency in India. In SN, all states in India were impacted by the Naxalite insurgency and the approach was used to study the effects of a State's attempt to combat the insurgents, as opposed to the traditional approach by AG that studies the impact of the treatment (terrorism). In our analysis, the fluctuation of world oil price affects all countries (analogous to terrorism in India), but the way that the resulting volatility is dealt with differs from country to country, depending on their level of financial development.

3.2.1 Constructing the Synthetic control country

Consider a given set of control and treatment groups. Let $\boldsymbol{W} = \left(w_1, w_2, \dots, w_j\right)$ be a $(J \times 1\ )$ vector of non-negative weights, where the w_j is the weight applied to the control country *j* in the resulting synthetic control corresponding to a given treatment country (if $w_j = 0$, there no influence of country j on the synthetic control). Naturally, different vectors of ***W*** will generate different synthetic controls. As a result, the optimal vector ***W*** is obtained by minimizing the following equation

$$(\boldsymbol{X_1} - \boldsymbol{X_0 W})'\boldsymbol{V}(\boldsymbol{X_1} - \boldsymbol{X_0 W})$$

Subject to $w_j \geq 0\ for\ all\ j$ and $w_1 + w_2 + \cdots + w_j = 1$,

where $\boldsymbol{X_1}$is a $(K \times 1\ )$ vector of pretreatment GDP predictors for the treated country;

$\boldsymbol{X_0}$ is a $(K \times J\ )$ vector of the same pretreatment GDP predictors for the control countries,

V is a diagonal matrix of non-negative components reflecting the importance of the different GDP predictors. AG suggests that the optimal choice of ***V*** is one where the resulting synthetic control best matches the pretreatment GDP level of the treated country[6].

The resulting optimal weight vector ***W**** is then applied to the GDP of the control countries to obtain the resulting synthetic control. i.e. if

$\boldsymbol{Y_1}$is a $(T \times 1\ )$ vector of output levels for the treated country

$\boldsymbol{Y_0}$is a $(T \times J\ )$ vector of output levels for the control countries,

The resulting synthetic control for the treated country will be

[6] The Stata "synth" command generates the optimal weights for the choice of control countries.

$$Y_1^* = Y_0 W^*$$

3.2.2 Adapting this approach to fit our analysis

Before we can apply this methodology to our analysis there are a few hurdles that have to be crossed with respect to the overall approach, the data, and the interpretation of results. These issues are discussed in this section.

3.2.2.1 Overall approach and interpretation of findings

Our purpose is to highlight the effect of differences in financial depth across oil rich countries on their ability to deal with oil price volatility, particularly with respect to the recent decline of oil prices starting in the first quarter of 2014. To do this, we perform a first cut of the initial dataset by selecting countries that are in the 75th percentile with regard to annual oil value to GDP ratio[7]. This focuses attention on countries (in both the control and treatment groups) that are relatively more dependent on oil and as such, would be greatly impacted by oil price volatility. However, since oil price variations affect all countries equally one must seek out a variable that transmits oil price volatility into country level effects, and thus captures cross country variation, while also reflecting oil price volatility. The most commonly impacted variable is naturally the output level, making GDP an appropriate variable to measure the impact of oil volatility. We proceed to divide the selected countries into two groups; one group with above-median levels of financial development (Group A), and the second, having below-median levels of financial development (Group B)[8]. Countries in Group A constitute the *potential* set of countries that would eventually be used to construct synthetic controls corresponding to each of the countries in group B (the treated group). As a proof of concept in this iteration of the paper, we begin with only 5 countries in the treated group. Since this is work in progress we will increase this number of countries in the treatment group significantly.

In order to highlight the effect of financial depth, the measures of financial depth are omitted from the set of output predictor variables used in the synthetic control construction. This is done such that the choice of the weighting vector does not match the financial measures of the synthetic control to the treated country. As a result, the synthetic controls have higher levels of financial development than the

[7] Oil to GDP ratio is calculated using the Oil and Gas data from Ross (2013), available at http://thedata.harvard.edu/dvn/dv/mlross

[8] The median used for this separation is the median of the average of all financial subset measures in the Fraser chain linked index. The list of countries in each group is provided in the appendix.

treated country[9]. Furthermore, apart from our proposed indirect effect of financial depth on output through oil price volatility mitigation, there is also the well documented direct effect of financial development on output (Levine 1997). This implies that we do not expect the pretreatment output levels to be a close match and should differ with varying degrees, depending on how much dispersion there is between financial development measures of the synthetic control and the treated country. As a result, we do not place much emphasis on differences in the level of output, but on the differences in output volatility between the treated countries and synthetic control. This implies that even though we have a particular interest in the post 2014 effect, the entire period estimated can be treated as a counterfactual when attention is focused on the volatility of output[10]. We take advantage of this unique property in our robustness checks (placebo tests). When we carry out the same process using countries with high financial development measures (Group A), we expect the output levels of both the synthetic control and the "treated" country to better align due to similar financial measures. This will add an extra layer of verification when these placebo tests are carried out (in addition to similar fluctuations in output in the post treatment period for both the synthetic control and treated country).

3.2.2.2 Data

We make use of quarterly data (between 2006:Q1 and 2015:Q4) for this analysis to get more time observations post 2014. For a majority of the countries with poor financial measures, quarterly observations on key variables are not reported and as a result, these variables need to be estimated. In the time period chosen, quarterly data on imports and exports were the only data points available for all countries in our analysis. We therefore use these variables to generate output levels. We first obtain annual measures of trade to GDP ratio, then assuming that these ratios remain constant over all quarters of that year, we use the quarterly sums of exports and imports to generate quarterly output

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[9] By design, the financial development measure of the treated country is less than the lowest measure in the set of control variables. Since the weighted average of the financial measures of the control countries would yield a measure that is greater than or equal to the lowest measure, the resulting synthetic control's financial measure is still larger than the treated county's.

[10] We can make this assumption because first, oil is a major component of the GDP of these countries, so a fluctuation in oil prices would reveal itself in the fluctuation of output levels. Second while 2014 offers a significant decline in the price of oil (increasing volatility), other time periods examined also have oil price fluctuations especially the hike in oil price in 2007/2008. A combination of these two points suggests that an examination of the entire time period paints a clearer picture of the effect of financial depth on mitigating oil volatility. Furthermore, there is no significant time period with constant oil prices (zero volatility) so that counterfactual study is not possible.

levels for each country. As a robustness check, we also generate an alternate measure of output using the import to GDP ratio that has been more commonly practiced in the literature (see later)[11]. We faced similar data restrictions with respect to the predictor variables. To overcome these limitations, we made similar assumptions that the variables remained constant across all quarters for each year[12].

3.3 Results and Interpretation

Table 5 shows the optimal weights assigned to each potential control country for each treated country. To highlight the effectiveness of the matching process (with the preference slanted towards matching output levels), table 6 shows the averages of the predictor variables for all treated countries as well as their corresponding counterfactual synthetic controls. We find that the difference in these variables between the synthetic controls and the treated variables are not too pronounced, suggesting that the counterfactual measure and the treated countries are indeed similar in those respects. Figures 1 through 5 show the output of both the synthetic control and the treated countries. Given that oil volatility is an ongoing phenomenon, the oil price decline of post 2014 period is not unique but one in the history of oil price volatility in the post-World War period. As such, we do not have a classic pre-treatment period in which control and treatment countries would exhibit identical behavior. Rather, our control and treatment group differ by their financial depth and as such the figures exhibit this difference.

For all of the countries treated, it appears that the synthetic controls exhibit less volatility in output levels, suggesting a greater mitigation of oil price volatility through higher levels of financial development. To be certain, table 7 captures the standard deviation (as well as the ratio of these standard deviations) of the synthetic controls and the treated countries for three time periods: the full study period, the pretreatment period and the post treatment period. We find that in the full period, all 5 treated countries have more volatile output than their respective counterfactual synthetic controls, with only 3 of these being statistically significant. All treated countries also exhibit more volatile output in the pretreatment period with the same 3 being significant. Finally, only two out of the 3 that had

[11] For some countries in 2015 that have missing trade to GDP data as well as missing import to GDP data, we assumed that the change in the ratio in the preceding year persisted and used that to generate GDP measures for those missing time periods. This is not unreasonable as these are countries that rely heavily on oil production and whatever decline existed between 2013 and 2014 was sure to continue due to declining oil prices.

[12] This is also not unreasonable as we do not expect significant changes in capital stock or human capital development between each quarter of a particular year.

more volatile output in the pretreatment period showed significantly higher volatility in the post treatment period. While these results strongly support our hypothesis, the anomalous behavior highlighted in some of the countries is worth exploring and will serve to solidify our findings and provide further insight. For example, the fact that some of these countries show similar post treatment volatility is counter intuitive. There are two possible reasons for these anomalies. The first is that the difference between the financial measures in treated and synthetic control group, is negligible and as such, has no discernable impact when oil prices drop. The second reason is a vast difference in the estimates of the dependence on oil between the synthetic and treated groups. The 75th percentile cutoff that we employ includes countries with a significant range of oil value as a ratio of GDP, as a result, it is possible that the synthetic control group severely under or overestimate the oil to GDP ratio of the treated country, as this variable is not included as a predictor. This is primarily because quarterly data on this is not available for the countries of interest, and making the assumption that oil production does not change from quarter to quarter is less plausible. To determine which explanation is responsible for the anomalous behavior, table 8 shows the financial depth measures and oil to GDP ratios (average of annual data) for the treated and synthetic control countries. From this table, we can see that most synthetic controls underestimate the dependence on oil in these countries, leading to the observed outcome. This discrepancy suggests that while oil volatility may be the reason for the oil curse, the abundance/dependence on oil plays a role as well in the financial sector's ability to mitigate fluctuations in oil price. This suggests that the level of financial development should be increasing in abundance/dependence on oil in a country.

3.4 Robustness checks

The findings highlighted above provide some insight as to the reliability of the role of financial development in mitigating the effects of oil price volatility in oil rich countries. Before we can ratify these findings, we must first perform some tests to ensure that these findings are indeed robust.

3.4.1 Addressing GDP estimates

To provide some robustness to our estimates of output levels, we generate a different measure of output using the import to GDP ratio, as opposed to the total trade to GDP ratio, given the well-established literature on marginal propensity to import resulting from changes in GDP[13]. We replicate

[13] See Chang 1946, Shinohara 1957, and Golub 1983

the same analysis using this different measure of Output. Table 9 which replicates 6 using the new GDP measure shows the optimal weights assigned to each potential control country and table 11 which replicates 7, shows the differences in volatility between treated and control countries[14]. With this new measure of GDP, we find similar behavioral patterns in the treated countries that were present using the initial output measure. Table 11 which replicates 8 also confirms that the anomalous behavior patterns that are also observed here, are due to the differences in oil to GDP ratio and not to similar measures of financial depth.

3.4.2 Accounting for Capital controls

One possible argument countering these findings may be that different levels of capital controls between the control and the treated countries might be the driving force behind these results. For example, it could be that control countries were on average more open and treated counties were on average are less open. We account for this possibility by including the *de-jure* measure of financial openness from Chinn and Ito (2006) that captures the degree of capital controls for each country in the set of predictor variables. While this is also an annual measure, it is very persistent and, as such, we assume that it remains generally constant across quarters. We repeat the process accounting for this measure of capital restrictions using both measures of output. Tables 12 and 13 show similar results to that of tables 7 and 8 using the original estimates of GDP, while tables 14 and 15 show similar results to that of tables 10 and 11. Given the similarities between these sets of tables, capital controls do not appear to have an impact on the results.

3.4.3 Accounting for Oil rents

Given the findings that oil abundance/dependence may affect the ability of the financial sector to mitigate volatile oil prices, we attempt to account for this abundance. Using annual oil rents as a percentage of GDP (where oil rents is defined as the difference between oil revenue and production costs) and assuming that these fractions remain consistent in each quarter, we carry out the same analysis by including oil rents in the list of predictors[15]. Table 16 shows the result of this analysis with an

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[14] The resulting figures and predictor variable comparison for this robustness check are not reported in the paper but are available upon request.

[15] We recognize that this is not an ideal measure of abundance, as we would expect to observe not only that costs of production differ across countries (based on type of oil and ease of extraction), but the likelihood that this measure is constant across all quarters for the same year is also unlikely given the volatility in oil prices at a monthly level. Furthermore, the annual data on oil value from Ross 2013 ends at 2011, so no further analysis can be undertaken pass that point. We expect that the oil rent measure, despite its drawbacks, will capture some information about the dependence on oil in these countries for the time period of interest and produce more accurate synthetic controls for the treated countries.

added column capturing the percentage over(under)estimation of oil rents between the treated and control countries. From this table, we find that Nigeria which has a 14% discrepancy in synthetic oil rent estimates still shows more volatility in the post treatment period. A more generous cut off point of a 36% discrepancy in oil rent shows that the finding for Angola still holds. Table 17 shows a reduction in the difference between the oil value per GDP measure when compared to earlier estimates highlighting that the oil rents data did create more accurate synthetic controls for the treated countries.

3.4.5 Placebo Tests

As is typical in counterfactual methodologies, we also perform placebo tests as a measure of robustness. Here, we assume that the control countries with superior financial development measures have subpar financial measures and run the same analysis, one control country at a time. When one of these control countries is being "treated", it is eliminated from the set of control countries. As was earlier stated, we expect two outcomes: first we expect a better fit between the treated and synthetic control countries, highlighting the effect of having similar financial measures; second we expect no significant difference between volatility measures when compared to the treated countries. Given our finding of the role of abundance of oil and the effect of oil rent in mitigating this effect in our analysis, we include oil rent as a predictor variable[16]. Table 18 reports the differences in volatility between the treated and the control countries as well as the percentage difference in oil rent estimates for this placebo tests[17]. We find no significant difference between the volatility measures for the majority of cases. In particular, cases that are contrary to our argument are typically those that have a higher discrepancy in oil rents estimates (Malaysia and Vietnam)[18]. In addition, we find that with the exception of these three peculiar cases, the significant post-treatment ratio of volatilities in the placebo tests are insignificant. This suggests that while other variables that influence growth volatility are omitted, their effects do not drive our results[19].

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[16] The figures depicting the output levels of the treated and synthetic control countries for the placebo tests are found in the appendix and we find that there are better matches in the entire period for most countries, highlighting the effect of the differences in the financial depth measure in the main analysis.

[17] Mexico and Brunei are left out of this analysis as the resulting Hessian matrix during the minimization process was asymmetric and could not be inverted. Thus, we are unable to generate optimal weights or synthetic controls.

[18] An interesting case is that of Norway that shows only a 5.9% discrepancy in oil rents estimates. It should be noted however that perhaps the reason for this higher volatility in Norway's output could be due to the European recession that hit the region in this post treatment period.

[19] These omitted variables could potentially explain the significant volatility differences in the countries under investigation. Given that the differences in the placebo tests are insignificant, they are at most, a very miniscule part of our findings and not the cause.

4. Conclusion

Recent studies of resource curse have discovered that the curse is driven, not so much by abundance itself, but by the volatility of the resource revenue. As a result, it has been suggested that better institutions may mitigate the negative effects of resource volatility on economic growth. In this study which focuses on oil *price* volatility, we offer a more precise channel through which this mitigation is achieved: a country's level of financial depth. This is based on a key role of finance, its diversification of risk. We investigate this proposition in two distinct ways: the first is an ARDL estimation to capture the degree to which financial depth mitigates the negative effect of oil volatility. The second is a counterfactual approach, using the synthetic control methodology, in which we examine the output volatility in oil rich countries with the counterfactual being realized output volatility with increased financial depth.

For the ARDL approach, we find that the financial measures do mitigate the effects of oil price volatility as the introduction of these measures reduce or completely eliminate the negative effects of oil volatility on growth. We also test the impact of openness on mitigating the effects of oil volatility and find that trade openness (measured by the sum of exports and imports as a fraction of GDP) and the de facto measure of financial openness (measured by the sum of assets and liabilities as a fraction of GDP) do not appear to have any mitigating effects of oil price volatility. The de jure measure of financial openness however, (which captures the degree of capital flow restrictions) suggests some measure of mitigation.

The counterfactual exercise corroborates our findings that financial depth does indeed mitigate oil price volatility. This is evidenced by the fact that the counterfactuals which posit the alternative scenario where treated countries have higher financial depth measures, show a significant decrease in output volatility. We also find that the ability of a financial system to adequately counteract the effects of oil price volatility depends on the degree of dependence of a country on oil. This suggests that the more dependent on oil a country, the higher its level of financial depth should be.

The policy implications of this paper are quite clear. The adverse consequences of the volatility of natural resources in general and oil in particular, can be overcome with better financial institutions. For the resource-rich MENA countries, the key policy question is exactly how and which financial institutions can yield the greatest social gain in this regard. Our study has provided some pathways in this direction.

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Figures 1 - 5: Treated countries vs. synthetic control

Figure 1

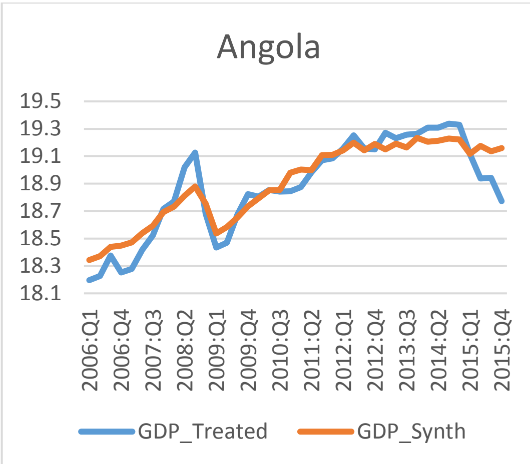


Figure 2

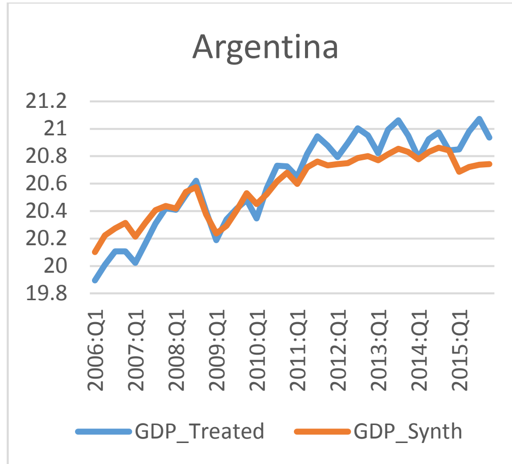


Figure 3

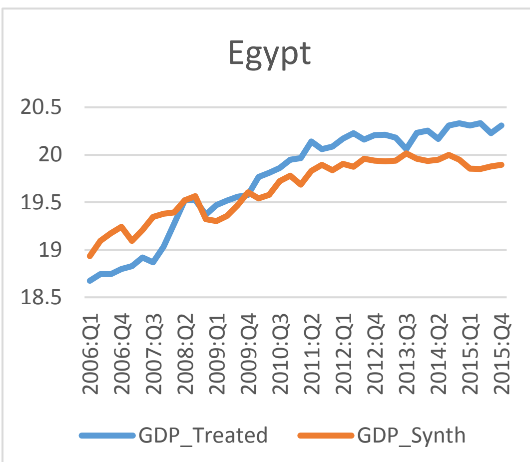


Figure 4

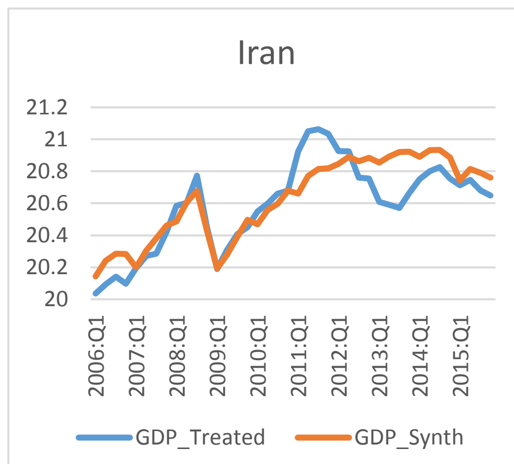


Figure 5

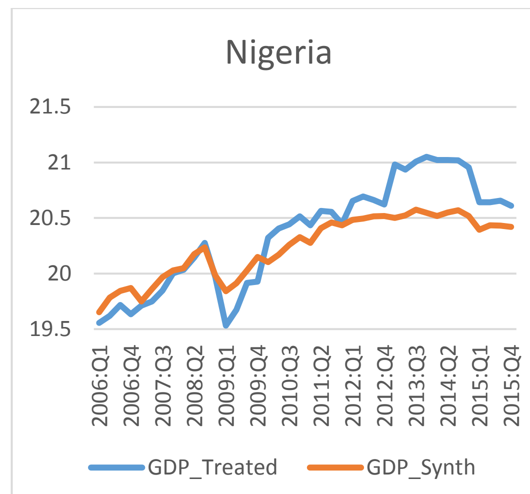


Table 2: Oil Price Volatility and Income: Baseline Results

	Growth Rates										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Oil Growth		0.0368***	0.0233*	0.0477***	0.0483***	0.0532***	0.0524***	0.0486**	0.0451**	0.0635***	0.0638***
		(0.0108)	(0.0120)	(0.0176)	(0.0176)	(0.0180)	(0.0179)	(0.0201)	(0.0198)	(0.0190)	(0.0191)
Oil Vol.			-0.00129***	-0.000510	0.00343	-0.000648*	0.000304	-0.00128***	-0.00253***	-0.000564	-0.000860
			(0.000473)	(0.000341)	(0.00250)	(0.000348)	(0.000881)	(0.000396)	(0.000831)	(0.000356)	(0.000925)
Lag of GDP	-0.0648***	-0.0655***	-0.0629***	-0.107***	-0.112***	-0.132***	-0.129***	-0.121***	-0.108***	-0.134***	-0.131***
	(0.00756)	(0.00753)	(0.00751)	(0.0247)	(0.0249)	(0.0251)	(0.0249)	(0.0269)	(0.0265)	(0.0253)	(0.0252)
Cap. Stock	0.0234***	0.0202**	0.0236***	0.0343	0.0371	0.00701	0.00821	-0.0455	-0.0502	0.00553	0.00459
	(0.00833)	(0.00832)	(0.00835)	(0.0278)	(0.0279)	(0.0267)	(0.0266)	(0.0313)	(0.0308)	(0.0268)	(0.0267)
Pop.	0.00879	0.00176	0.0159	0.00165	-0.0135	0.0479	0.0526	0.0324	0.0393	0.0421	0.0399
	(0.0136)	(0.0137)	(0.0143)	(0.0470)	(0.0480)	(0.0496)	(0.0493)	(0.0630)	(0.0621)	(0.0490)	(0.0489)
Education	-0.00933***	-0.00891***	-0.0140***	-0.00934**	-0.0108***	-0.0126***	-0.0113***	-0.0198***	-0.0175***	-0.0144***	-0.0141***
	(0.00306)	(0.00304)	(0.00355)	(0.00374)	(0.00387)	(0.00386)	(0.00394)	(0.00463)	(0.00462)	(0.00417)	(0.00425)
Fraser Index				-0.00257	0.00112						
				(0.00799)	(0.00833)						
Fraser Index-Oil Volatility Interaction					-0.000578						
					(0.000364)						
Gov. Cons.						0.00229	0.00366				
						(0.00406)	(0.00420)				
Gov. Con. – Oil Vol. Interaction							-0.000154				
							(0.000132)				
Jud. Ind.								0.00496	0.00339		
								(0.00386)	(0.00392)		
Jud. Ind – Oil Vol Interaction									0.000247*		
									(0.000145)		
Imp. Courts										0.00485	0.00503
										(0.00369)	(0.00385)
Imp. Court – Oil. Vol Interaction											0.0000607
											(0.000191)
Error correction	-0.809***	-0.810***	-0.812***	-1.071***	-1.070***	-1.011***	-1.015***	-0.844***	-0.854***	-1.010***	-1.012***
	(0.0213)	(0.0213)	(0.0213)	(0.0451)	(0.0451)	(0.0432)	(0.0432)	(0.0480)	(0.0478)	(0.0433)	(0.0433)
Countries	155	155	155	95	95	109	109	101	101	109	109
Observations	2248	2248	2248	625	625	687	687	580	580	686	686

Notes: Annual yearly data. Dependent variable is growth and estimation methodology is ARDL dynamic fixed effects. Column 1 is the standard growth empirical model, where growth is determined by lag level of GDP, capital stock, population (Pop) and secondary school education. Column 2 introduces oil price growth effects, and column 3 captures both oil growth and oil volatility (oil. vol). Columns 4 and 5 introduce the composite Fraser chain link index and the interaction of this index and oil volatility respectively. The introduction of these measures eliminate the significance of oil volatility on growth which corroborates the findings of the Mohaddes and Leong (2011). Columns 6-11 show the effects of some of the subcomponents components of the Fraser chain index: Government Consumption, Judicial Independence and Impartial courts. See text for interpretation and discussion of the results.

Table 3: Oil Price Volatility and Income: Role of Financial Institutions and Markets

	Growth Rates								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Oil Growth	0.0233*	0.0561***	0.0557***	0.0494***	0.0508***	0.0553***	0.0538***	0.0544***	0.0543***
	(0.0120)	(0.0182)	(0.0180)	(0.0179)	(0.0180)	(0.0184)	(0.0182)	(0.0179)	(0.0178)
Oil Vol.	-0.00129***	-0.000589*	0.00118	-0.000490	0.0000743	-0.000777**	0.00336	-0.000629*	0.00373**
	(0.000473)	(0.000357)	(0.000814)	(0.000348)	(0.00134)	(0.000360)	(0.00215)	(0.000351)	(0.00179)
Lag of GDP	-0.0629***	-0.126***	-0.126***	-0.133***	-0.133***	-0.128***	-0.130***	-0.128***	-0.127***
	(0.00751)	(0.0247)	(0.0245)	(0.0246)	(0.0246)	(0.0247)	(0.0246)	(0.0245)	(0.0242)
Cap. Stock	0.0236***	0.00639	-0.000610	0.00892	0.00915	0.00794	0.0151	0.00589	0.00217
	(0.00835)	(0.0270)	(0.0268)	(0.0266)	(0.0266)	(0.0269)	(0.0270)	(0.0266)	(0.0264)
Pop.	0.0159	0.0462	0.0503	0.0466	0.0437	0.0430	0.0324	0.0445	0.0364
	(0.0143)	(0.0493)	(0.0488)	(0.0483)	(0.0485)	(0.0537)	(0.0535)	(0.0490)	(0.0487)
Education	-0.0140***	-0.0118***	-0.0122***	-0.0113***	-0.0113***	-0.0118***	-0.0116***	-0.0123***	-0.0126***
	(0.00355)	(0.00392)	(0.00388)	(0.00386)	(0.00386)	(0.00401)	(0.00398)	(0.00389)	(0.00385)
Own. Bank.		-0.000982	0.000492						
		(0.00177)	(0.00185)						
Own bank. – Oil. Vol. Interaction			-0.000232**						
			(0.0000966)						
Pri. Sec. Cre.				-0.00149	-0.000827				
				(0.00145)	(0.00198)				
Pri. Sec. Cre. – Oil. Vol. Interaction					-0.0000643				
					(0.000151)				
Int. rate con.						0.00661**	0.00949***		
						(0.00288)	(0.00336)		
Int. rate con. – Oil. Vol. Interaction							-0.000451*		
							(0.000231)		
Cre. Mar. reg.								0.0000508	0.00406
								(0.00281)	(0.00323)
Cre. Mar. reg. – Oil. Vol. Interaction									-0.000515**
									(0.000209)
Error correction	-0.812***	-1.017***	-1.024***	-1.007***	-1.007***	-1.010***	-1.011***	-1.014***	-1.019***
	(0.0213)	(0.0436)	(0.0436)	(0.0428)	(0.0428)	(0.0434)	(0.0431)	(0.0431)	(0.0430)
Countries	155	104	104	110	110	109	109	110	110
Observations	2248	672	672	689	689	667	667	689	689

Notes: Annual yearly data. Dependent variable is growth and estimation methodology is ARDL dynamic fixed effects. Column 1 replicates the standard empirical model with oil growth and volatility. Columns 2 through 9 introduce the different local financial subcomponents of the Fraser index we believe have an impact on mitigating volatility: Ownership of Banks, private sector credit, Interest rate controls, and credit market regulations. These are the variables that were positively correlated with the overall Fraser chain index measure. These perform well generally, as the introduction of each variable weakens the significance of oil volatility and the interaction term eliminates it. An exception is column 9. For discussion see the text.

Table 4: Oil Price Volatility and Income: Role of International Market Openness

	Growth Rates						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Oil Growth	0.0233*	0.0349***	0.0355***	-0.000991	-0.00145	0.0143	0.0142
	(0.0120)	(0.0131)	(0.0131)	(0.0115)	(0.0114)	(0.0112)	(0.0112)
Oil Vol.	-0.00129***	-0.00132***	-0.00128**	-0.00141***	-0.00153***	-0.00116***	-0.000795
	(0.000473)	(0.000501)	(0.000501)	(0.000328)	(0.000336)	(0.000431)	(0.000639)
Lag of GDP	-0.0629***	-0.0680***	-0.0692***	-0.0453***	-0.0428***	-0.0552***	-0.0555***
	(0.00751)	(0.00861)	(0.00864)	(0.0155)	(0.0155)	(0.00711)	(0.00713)
Cap. Stock	0.0236***	0.0359***	0.0374***	-0.0250	-0.0272	0.0202**	0.0199**
	(0.00835)	(0.0100)	(0.0101)	(0.0198)	(0.0198)	(0.00823)	(0.00824)
Pop.	0.0159	0.0188	0.0193	0.0839**	0.0883***	0.0202	0.0195
	(0.0143)	(0.0150)	(0.0150)	(0.0336)	(0.0336)	(0.0138)	(0.0139)
Education	-0.0140***	-0.0155***	-0.0160***	-0.00905***	-0.00874***	-0.00529	-0.00596*
	(0.00355)	(0.00389)	(0.00391)	(0.00324)	(0.00324)	(0.00342)	(0.00353)
Trade open.		-0.0130***	-0.0145***				
		(0.00468)	(0.00476)				
Trade open – Oil. Vol. Interaction			0.000228*				
			(0.000132)				
Fin. Open. DF				0.00837**	0.00746**		
				(0.00328)	(0.00333)		
Fin. Open. DF – Oil. Vol. Interaction					0.000152		
					(0.000108)		
Fin. Open. DJ						0.00815	0.0120
						(0.00870)	(0.0101)
Fin. Open. DJ – Oil. Vol. Interaction							-0.000701
							(0.000910)
Error correction	-0.812***	-0.819***	-0.819***	-0.878***	-0.882***	-0.888***	-0.888***
	(0.0213)	(0.0220)	(0.0220)	(0.0334)	(0.0336)	(0.0227)	(0.0227)
Countries	155	143	143	102	102	149	149
Observations	2248	1998	1998	901	901	2018	2018

Notes: Annual yearly data. Dependent variable is growth and estimation methodology is ARDL dynamic fixed effects. The report that follows focuses on the long run effects as the short run should not matter in this context. Column 1 replicates the standard empirical model with oil growth and volatility. Columns 2 through 7 introduce different openness measures and the interaction between these measures and oil volatility. We see that trade openness has a negative effect on growth but helps mitigate the effect of oil volatility (positive coefficient of the interaction term) but does not entirely eliminate the negative effects of volatility. The de-facto financial measure (DF) contributes to overall growth but eliminates the positive effect of oil growth on growth rates while doing nothing to mitigate oil volatility. The de-jure measure of financial openness (DJ) also eliminates the positive effect of oil growth but eliminates the negative effects of oil volatility.

Table 5: Optimal weights of potential control countries

Treated	Possible Control Countries							
	Bahrain	**Brunei Darussalam**	**Malaysia**	**Mexico**	**Peru**	**Viet Nam**	**Norway**	**Saudi Arabia**
Angola	0.566	0.133	0	0	0	0	0	0.302
Argentina	0	0	0	0.457	0.543	0	0	0
Egypt	0	0	0	0.008	0.992	0	0	0
Iran	0.064	0	0	0.262	0.23	0	0	0.444
Nigeria	0	0	0	0.138	0.596	0	0	0.266

Table 6: Predictor Variable comparison

	Angola		**Argentina**		**Egypt**		**Iran**		**Nigeria**	
Capital Stock	13.272	12.950	14.364	14.364	13.791	13.402	14.962	14.654	14.105	14.154
Imports	22.160	22.292	23.307	23.845	23.137	22.767	23.477	23.889	23.217	23.425
Exports	23.199	23.204	23.504	23.842	22.493	22.858	23.889	24.310	23.685	23.686
Trade	23.507	23.546	24.106	24.540	23.562	23.510	24.405	24.839	24.175	24.275
GDP	18.801	18.822	20.535	20.525	19.590	19.563	20.549	20.561	20.211	20.167
Human capital	1.406	2.393	2.839	2.661	2.329	2.717	2.092	2.555	1.738	2.640
Trade to GDP ratio	110.987	114.269	35.769	55.695	54.159	51.912	47.485	75.013	54.059	62.565

Table 7: Ratio of output volatility between treated and synthetic controls

	Full			Pre 2014:Q1			Post 2014:Q1		
	Treated country (TC)	Synthetic control (SC)	TC/SC	Treated country	Synthetic control	TC/SC	Treated country	Synthetic control	TC/SC
Angola	0.343	0.284	1.205	0.336	0.271	1.239	0.201	0.040	5.032***
Argentina	0.336	0.218	1.541***	0.331	0.213	1.552***	0.081	0.059	1.384
Egypt	0.544	0.307	1.775***	0.525	0.303	1.731***	0.053	0.048	1.109
Iran	0.273	0.251	1.087	0.296	0.246	1.202	0.057	0.071	0.800
Nigeria	0.481	0.276	1.741***	0.444	0.273	1.629***	0.189	0.062	3.023***

*,**,*** represent 10%, 5% and 1% respectively. Tests of standard deviations are based on the variance ratio test

Table 8: Differences in financial depth measures and oil value

	Financial Depth Measure			Oil Value/GDP		
	Treated country (TC)	Synthetic control (SC)	TC - SC	Treated country(TC)	Synthetic control (SC)	TC - SC
Angola	7.748	8.989	-1.241	0.608	0.219	0.389
Argentina	6.902	8.308	-1.406	0.044	0.059	-0.015
Egypt	6.045	8.256	-2.211	0.147	0.039	0.108
Iran	4.785	8.465	-3.680	0.253	0.233	0.020
Nigeria	7.748	8.340	-0.593	0.416	0.153	0.263

Table 9: Optimal weights of potential control countries (Alternative GDP measure robustness check)

Treated	Possible Control Countries							
	Bahrain	**Brunei Darussalam**	**Malaysia**	**Mexico**	**Peru**	**Viet Nam**	**Norway**	**Saudi Arabia**
Angola	0.817	0	0	0.153	0.03	0	0	0
Argentina	0	0	0	0.404	0.596	0	0	0
Egypt	0	0	0	0.076	0.924	0	0	0
Iran	0	0	0	0	0.141	0	0	0.859
Nigeria	0.139	0	0	0	0	0	0	0.861

Table 10: Ratio of output volatility between treated and synthetic controls (Alternative GDP measure robustness check)

	Full			Pre 2014:Q1			Post 2014:Q1		
	Treated country (TC)	Synthetic control (SC)	TC/SC	Treated country	Synthetic control	TC/SC	Treated country	Synthetic control	TC/SC
Angola	0.320	0.326	0.980	0.261	0.300	0.873	0.280	0.028	10.001***
Argentina	0.343	0.237	1.446**	0.340	0.231	1.470**	0.062	0.057	1.088
Egypt	0.554	0.308	1.797***	0.532	0.303	1.754***	0.098	0.050	1.939**
Iran	0.413	0.330	1.251*	0.404	0.330	1.225	0.062	0.090	0.682
Nigeria	0.565	0.335	1.687***	0.507	0.331	1.532**	0.078	0.081	0.961

*,**,*** represent 10%, 5% and 1% respectively. Tests of standard deviations are based on the variance ratio test

Table 11: Differences in financial depth measures and oil value (Alternative GDP measure robustness check)

	Financial Depth Measure			Oil Value/GDP		
	Treated country (TC)	Synthetic control (SC)	TC - SC	Treated country(TC)	Synthetic control (SC)	TC - SC
Angola	7.748	9.082	-1.334	0.608	0.071	0.536
Argentina	6.902	8.302	-1.400	0.044	0.057	-0.013
Egypt	6.045	8.264	-2.219	0.147	0.042	0.105
Iran	4.785	8.480	-3.695	0.253	0.388	-0.135
Nigeria	7.748	8.618	-0.870	0.416	0.393	0.023

Table 12: Ratio of output volatility between treated and synthetic controls (Accounting for capital restrictions)

	Full			Pre 2014:Q1			Post 2014:Q1		
	Treated country (TC)	Synthetic control (SC)	TC/SC	Treated country	Synthetic control	TC/SC	Treated country	Synthetic control	TC/SC
Angola	0.343	0.315	1.088	0.336	0.278	1.210	0.201	0.040	4.997***
Argentina	0.336	0.294	1.143	0.331	0.291	1.136	0.081	0.089	0.913
Egypt	0.544	0.306	1.777***	0.525	0.303	1.733***	0.053	0.048	1.108
Iran	0.273	0.266	1.024	0.296	0.263	1.124	0.057	0.077	0.745
Nigeria	0.481	0.301	1.597***	0.444	0.298	1.489**	0.189	0.076	2.494***

Table 13: Differences in financial depth measures and oil value (Accounting for capital restrictions)

	Financial Depth Measure			Oil Value/GDP		
	Treated country (TC)	Synthetic control (SC)	TC - SC	Treated country(TC)	Synthetic control (SC)	TC - SC
Angola	7.748	9.179	-1.431	0.608	0.123	0.485
Argentina	6.902	8.451	-1.549	0.044	0.338	-0.294
Egypt	6.045	8.256	-2.211	0.147	0.039	0.108
Iran	4.785	8.413	-3.629	0.253	0.247	0.006
Nigeria	7.748	8.397	-0.649	0.416	0.259	0.157

Table 14: Ratio of output volatility between treated and synthetic controls (Accounting for capital restrictions with Alternative GDP)

	Full			Pre 2014:Q1			Post 2014:Q1		
	Treated country (TC)	Synthetic control (SC)	TC/SC	Treated country	Synthetic control	TC/SC	Treated country	Synthetic control	TC/SC
Angola	0.320	0.360	0.889	0.261	0.329	0.796	0.280	0.030	9.275***
Argentina	0.343	0.230	1.490***	0.340	0.224	1.515**	0.062	0.058	1.072
Egypt	0.554	0.308	1.797***	0.532	0.303	1.754***	0.098	0.050	1.939**
Iran	0.413	0.330	1.251*	0.404	0.330	1.225	0.062	0.090	0.682
Nigeria	0.565	0.326	1.730***	0.507	0.323	1.572***	0.078	0.070	1.102

*,**,*** represent 10%, 5% and 1% respectively. Tests of standard deviations are based on the variance ratio test

Table 15: Differences in financial depth measures and oil value (Accounting for capital restrictions with Alternative GDP)

	Financial Depth Measure			Oil Value/GDP		
	Treated country (TC)	Synthetic control (SC)	TC - SC	Treated country(TC)	Synthetic control (SC)	TC - SC
Angola	7.748	9.128	-1.380	0.608	0.133	0.474
Argentina	6.902	8.305	-1.404	0.044	0.058	-0.014
Egypt	6.045	8.264	-2.219	0.147	0.042	0.105
Iran	4.785	8.480	-3.695	0.253	0.388	-0.135
Nigeria	7.748	8.437	-0.689	0.416	0.270	0.145

Table 16: Differences in output volatility between treated and synthetic controls (Accounting for oil rent restrictions)

	Full			Pre 2014:Q1			Post 2014:Q1			
	Treated country (TC)	Synthetic control (SC)	TC /SC	Treated country	Synthetic control	TC/SC	Treated country	Synthetic control	TC/SC	Difference in oil rent
Angola	0.343	0.284	1.205	0.336	0.271	1.239	0.201	0.040	5.032***	-36%
Argentina	0.336	0.218	1.541***	0.331	0.213	1.552***	0.081	0.059	1.384	13%
Egypt	0.544	0.308	1.769***	0.525	0.304	1.725***	0.053	0.049	1.089	-63%
Iran	0.273	0.253	1.078	0.296	0.249	1.186	0.057	0.071	0.807	-25%
Nigeria	0.481	0.301	1.597***	0.444	0.298	1.489**	0.189	0.076	2.494***	14%

*,**,*** represent 10%, 5% and 1% respectively. Tests of standard deviations are based on the variance ratio test

Table 17: Differences in financial depth measures and oil value (Accounting for oil rent restrictions)

	Financial Depth Measure			Oil Value/GDP		
	Treated country (TC)	Synthetic control (SC)	TC - SC	Treated country(TC)	Synthetic control (SC)	TC - SC
Angola	7.748	8.989	-1.241	0.608	0.219	0.389
Argentina	6.902	8.308	-1.406	0.044	0.059	-0.015
Egypt	6.045	8.263	-2.218	0.147	0.051	0.096
Iran	4.785	8.380	-3.595	0.253	0.198	0.054
Nigeria	7.748	8.397	-0.649	0.416	0.259	0.157

Table 18: Ratio of output volatility between treated and synthetic controls (Placebo tests)

	Full			Pre 2014:Q1			Post 2014:Q1			
	Treated country (TC)	Synthetic control (SC)	TC/SC	Treated country	Synthetic control	TC/SC	Treated country	Synthetic control	TC/SC	Difference in oil rent
Bahrain	0.302	0.290	1.038	0.272	0.279	0.973	0.037	0.053	0.686	10%
Malaysia	0.279	0.289	0.964	0.266	0.264	1.008	0.069	0.021	3.279***	218%
Norway	0.147	0.165	0.895	0.144	0.159	0.910	0.152	0.066	2.290**	5.9%
Peru	0.308	0.287	1.075	0.305	0.248	1.228	0.048	0.051	0.935	398%
S. Arabia	0.303	0.208	1.459**	0.302	0.198	1.521**	0.107	0.070	1.528	-85%
Viet Nam	0.384	0.293	1.311**	0.303	0.277	1.093	0.132	0.034	3.918***	174%

*,**,*** represent 10%, 5% and 1% respectively. Tests of standard deviations are based on the variance ratio test

Appendix

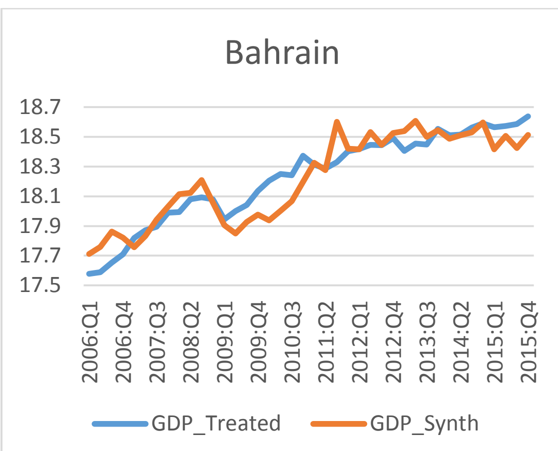
Data Sources

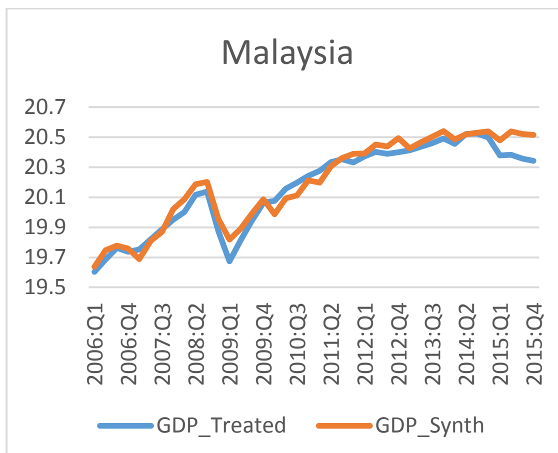
Variables	Source
Ownership of banks	Fraser chain linked index data set
Private sector credit	Fraser chain linked index data set
Interest rate controls negative	Fraser chain linked index data set
Credit market regulations	Fraser chain linked index data set
Government Consumption	Fraser chain linked index data set
Transfers and subsidies	Fraser chain linked index data set
Judicial independence	Fraser chain linked index data set
Impartial courts	Fraser chain linked index data set
Fraser chain linked Summary Index	Fraser chain linked index data set
Total Liabilities	IMF International Financial Statistics Database
Total assets	IMF International Financial Statistics Database
GDP	World Bank World Development Indicator Database
Human capital Index	Penn World Tables
Capital stock at constant 2011 national prices (in mil. 2011US$)	Penn World Tables
Chinn-Ito Dejure measure of financial openness	http://web.pdx.edu/~ito/Chinn-Ito_website.htm
oil rents to GDP ratio	World Bank World Development Indicator Database
Trade to GDP ratio	World Bank World Development Indicator Database
Import to GDP ratio	World Bank World Development Indicator Database
Oil Price	United States department of energy via quandl.com and OPEC (opec.org)
Exports	IMF International Financial Statistics Database
Imports	IMF International Financial Statistics Database

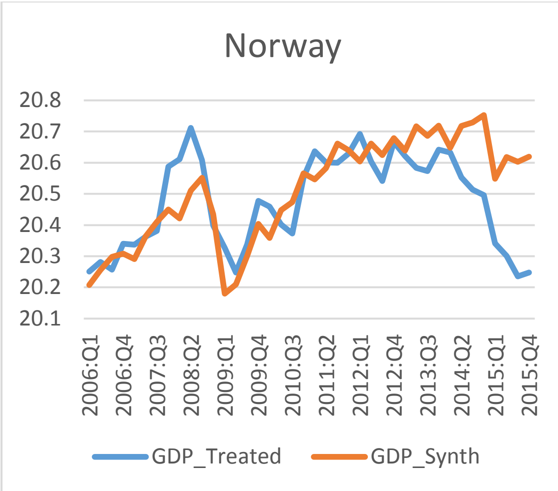
List of control and treated countries

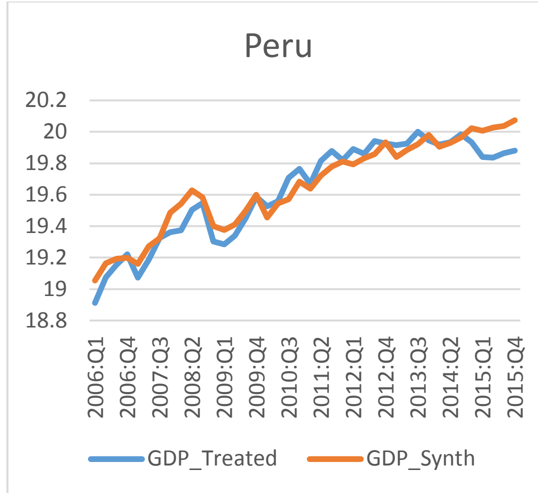
Treated countries	Control Countries
Angola	Bahrain
Argentina	Brunei Darussalam
Egypt	Malaysia
Iran	Peru
Nigeria	Mexico
	Vietnam
	Norway
	Saudi Arabia

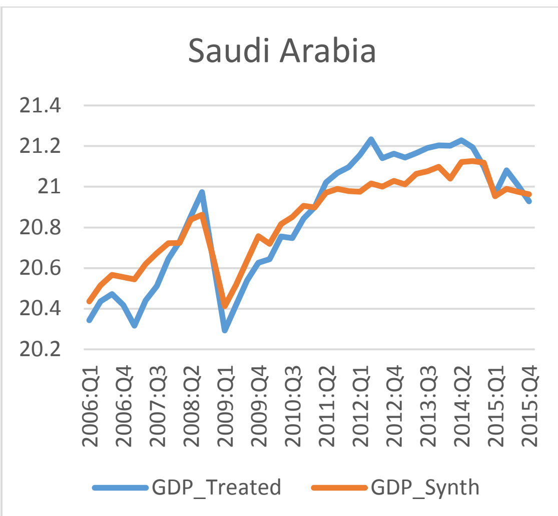
Figures of output (placebo tests): Treated countries vs. synthetic control

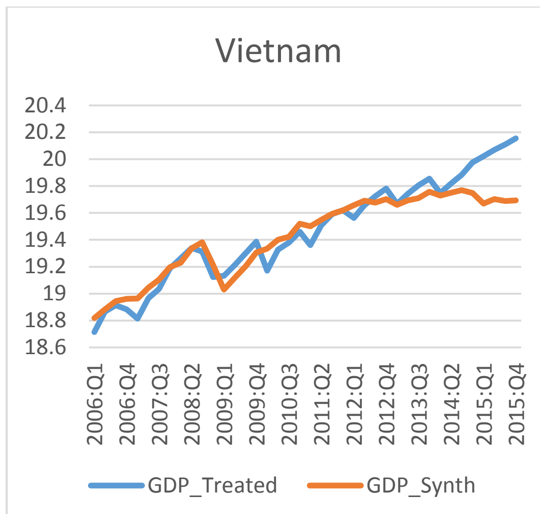





Norway
20.8
20.7
20.6
20.5
20.4
20.3
20.2
20.1
2006:Q1
2006:Q4
2007:Q3
2008:Q2
2009:Q1
2009:Q4
2010:Q3
2011:Q2
2012:Q1
2012:Q4
2013:Q3
2014:Q2
2015:Q1
2015:Q4
GDP_Treated
GDP_Synth


Peru
20.2
20
19.8
19.6
19.4
19.2
19
18.8
2006:Q1
2006:Q4
2007:Q3
2008:Q2
2009:Q1
2009:Q4
2010:Q3
2011:Q2
2012:Q1
2012:Q4
2013:Q3
2014:Q2
2015:Q1
2015:Q4
GDP_Treated
GDP_Synth


Saudi Arabia
21.4
21.2
21
20.8
20.6
20.4
20.2
2006:Q1
2006:Q4
2007:Q3
2008:Q2
2009:Q1
2009:Q4
2010:Q3
2011:Q2
2012:Q1
2012:Q4
2013:Q3
2014:Q2
2015:Q1
2015:Q4
GDP_Treated
GDP_Synth


Vietnam
20.4
20.2
20
19.8
19.6
19.4
19.2
19
18.8
18.6
2006:Q1
2006:Q4
2007:Q3
2008:Q2
2009:Q1
2009:Q4
2010:Q3
2011:Q2
2012:Q1
2012:Q4
2013:Q3
2014:Q2
2015:Q1
2015:Q4
GDP_Treated
GDP_Synth