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ESSAYS ON THE EFFECTS OF RESOURCE WEALTH AND US INFLUENCE ON EMPLOYMENT, EDUCATION AND EXPORT STRUCTURE

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by

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A Dissertation
Submitted in Partial Fulfillment of the Requirements for the
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TITLE: ESSAYS ON THE EFFECTS OF RESOURCE WEALTH AND US INFLUENCE ON EMPLOYMENT, EDUCATION AND EXPORT STRUCTURE

MAJOR PROFESSOR: Dr. Kevin Sylwester

Although several studies have sought to identify the determinants of export diversity and sophistication, few have examined the role of historical events in shaping or reshaping them. In my first chapter I use data on CIA interventions during the Cold War period. I show that such interventions had a negative impact on the range of goods exported by affected countries. I provide evidence that this effect persisted in the long run.

In my second chapter, I study the local impact of trade union strength on employment during resource booms. I use unionization and coverage rates along with the presence of state level right to work laws as proxies for weak unions. The empirical strategy limits the sample to resource abundant US counties that share a border across states and utilizes county pair-year fixed effects to compare average responses to oil booms in resource rich counties located in states with weak unions to responses in adjacent resource rich counties in states with relatively strong unions. Results suggest that within a relatively small geographic radius, union strength does not seem to have an impact on the response of employment to booms. There is some evidence to suggest that the results point to the existence of spillover effects where employment in weak union locations is influenced by proximity to strong unions.

In my final chapter I exploit variation in resource wealth between English speaking Caribbean nations who take identical exams at the secondary school level. I test the hypothesis that booms alter the incentive for academic excellence in secondary school students. To isolate the impact changing incentives have on academic performance, I control for education expenditure and other demand and supply side factors. Results suggest that booms improve performance mainly for female students.

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DEDICATION

To my loving wife who made this possible with her unwavering support.

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CHAPTER 1

CIA INTERVENTIONS AND EXPORT STRUCTURE

Introduction

Developed countries tend to export a wider range of goods than developing countries. One possible explanation in the literature is based on the concept of a resource curse where the progress of resource dependent countries is restricted by price volatility, Dutch disease, corruption, civil wars etc. However, the negative effects of price volatility for example, aren't limited to resource dependent countries. Tourism dependent small islands in the Caribbean typically experience fluctuations in fortune as oil price shocks impact their key tourism source countries (Vargas & Hess, 2019). Low levels of export diversification have been linked to low growth and macroeconomic volatility (IMF, 2014; Feenstra & Kee, 2008; Hesse, 2008; Mau, 2016). Although results are generally not linear or homogenous, there is significant evidence that developing countries (particularly poor resource abundant ones) stand to benefit by diversifying their typically concentrated exports (Lectard & Rougier, 2018; IMF, 2014; Hesse, 2008). This has led the governments of developing nations and organizations like the World Bank and IMF to actively research and promote export diversification.

Not only is it beneficial to export a diverse range of goods, studies suggest that the benefits a country can derive from export diversity also depend on the composition of the export basket. Where the successful discovery by one entrepreneur of a new profitable export line generates knowledge spillovers that can be harnessed by other entrepreneurs, the extent and quality of those spillovers matter. Knowledge spillovers associated with highly sophisticated products would generate greater increases in efficiency and growth than spillovers associated with mundane products. Hausmann et al. (2007) find that when there are knowledge spillovers, specialization in 'rich country' tradable goods tends to result in higher levels of productivity and economic growth than specialization in 'poor country goods'. Hidalgo et al. (2007) build on this work and show that countries tend to diversify into new products that are somehow related to their current range of products. Consequently, a country that exports a sophisticated range of goods that generate knowledge spillovers is likely to find itself on a trajectory that is characterized by higher export diversity, innovation and growth than one with basic exports. Hausmann et al. (2007) find that the sophistication of a nation's exports predicts future growth levels. Empirical results suggest that countries[1] with sophisticated exports grow faster than countries with lower levels of export sophistication (Hausmann et al., 2007; Hidalgo et al., 2007) they also have lower levels of income inequality (Hartmann et al., 2017).

Krugman (1987) shows via a theoretical model that when productivity depends significantly on learning by doing, a shock that restricts production of a particular good could erode a nation's comparative advantage in that product, thereby permanently altering its export basket. It follows then that a shock that alters a nation's range and/or composition of exports could have important implications for its growth path. A shock that causes an expansion in the range of sophisticated exports would generate positive spillover effects and raise prospects for future innovation and growth via the process discussed previously. On the other hand, a shock that destroys an export line restricts knowledge spillovers, limiting prospects for growth and the development of related new products. The negative impact on growth is likely to be more severe the more sophisticated the destroyed export line.

Given the importance export diversity and sophistication potentially play along the

[1] Research suggest that this may even be true for regions within a country. Jarreau & Ponchet (2012) demonstrate this effect within China.

structural change and development path of a country, several studies have examined the determinants of both. Results suggest that country size, relative productivity, factor endowments, institutional quality and trade openness are all important determinants of trade diversification (Giri et al., 2019; Cieslik & Parteka, 2021; Mau, 2016)[2]. Results from Lectard & Rougier (2018) suggest that industrial policy may play a role in improving export diversity and sophistication, although results are heterogeneous. However, few studies have examined the impact of historical events in shaping the export structure of a nation. Understanding this channel is important because it helps to explain the development trajectories of economies and why and how certain events altered this trajectory.

The Cold War period provides an opportunity to analyze the impact of a particular type of external shock on the diversity and sophistication of the exports of affected countries. During this period, two major superpowers, the US and Russia, vied for global influence. Government agencies from both countries attempted to bring other countries under their sway via covert and overt methods including coups, assassinations, the spread of propaganda and military support[3] (Berger et al., 2013b). One popular example involves Iran in the 1950s. After years of what was essentially British control over Iran's vast petroleum resources, the democratically elected Prime Minister Mohammad Mossadegh nationalized the main oil company Anglo-Iranian Oil Company. At the request of the British, the CIA orchestrated a coup in 1953 which overthrew Mossadegh, minimized the influence of the parliament and elevated the power of the monarchy.

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[2] In Mau (2016), GDP per capita and export diversification are endogenous with causation running both ways. Results differ based on how diversification is measured, whether focus is placed on the extensive or intensive margins etc.

[3] Military support includes training and the provision of weapons and/or finance.

The CIA supported the monarchy with military training and funding until the Iranian Revolution and the installation of Ayatollah Ruhollah Musavi Khomeini as the country's supreme leader in 1979.

Such interventions by the US could impact the export structure of affected countries via several channels. For example, Berger et al. (2013a) show that US interventions to prop up a leader in the Cold War period were associated with short to medium term deteriorations in democratic institutions. More directly, Berger et al. (2013b) show that CIA influence during the same period increased imports by affected nations from the US. This increase in US exports was found to occur for goods in which the US had a comparative disadvantage. This suggests that at least in some affected countries, US interventions would have undermined local production for export and/or consumption locally.

Consequently, this research seeks to ascertain the effects of US influence on the range and sophistication of exports of affected countries. Export diversification and sophistication are persistent variables. Therefore, if what you export matters in the sense that it affects aggregate levels of expertise and consequently the growth path, then any shock that significantly alters the set of goods that a country specializes in can have a profound impact on the future growth and development of that country. In this context, CIA interventions that destroyed certain export lines in a particular country may have had persistent negative effects. The research seeks to answer two questions:

1. Did CIA interventions affect the range of products exported by affected countries?
2. How did this intervention affect the sophistication of exports in affected countries?

Methodology

The empirical strategy largely follows Lectard & Rougier (2018) who regress export diversification and sophistication on a measure of comparative advantage defying industrial policy. They include a lagged dependent variable as a regressor and use GMM-system to estimate the model. My empirical strategy takes a similar approach as shown in equation (1.1) below. I separate my analysis to estimate both short and long run effects of CIA interventions. Equation (1.1) will be used to study the short-term effects.

$$EX_{i,t} = \beta_1 EX_{i,t-1} + \beta_2 USinfluence_{i,t} + \beta_3 \left(\frac{Y_{it}}{L_{it}}\right) + \beta_4 L_{it} + \gamma X_{i,t} + \mu_i + \delta_t + \varepsilon_{i,t} \quad (1.1)$$

In this specification, i and t index countries and years respectively. EX represents a measure of export diversification or sophistication which will be captured by the Theil index and the Export Complexity Index (ECI) respectively. $USinfluence$ is an indicator variable that captures successful CIA intervention to install and/or support a leader in a foreign country. Y and L stand for output and workers respectively. I control for output per worker and country size as Cieslik & Parteka (2021), using a Ricardian framework, find that both variables are key determinants of export diversification. X represents a vector of variables that control for successful Soviet interventions and democratic institutions. These variables represent key controls utilized by Berger et al. (2013b). I also control for trade openness and resource abundance as some argue that this is likely to contribute to CIA interventions and studies link resource abundance to export concentration (see Bahar & Santos, 2018). Finally, I control for time invariant differences across countries and global shocks with country and time fixed effects. Given the inclusion of a lagged dependent variable as a regressor and the likelihood that income per capita and export diversification may both impact each other, GMM-system will be utilized to address endogeneity concerns.

Cross-section regressions as given in equation (1.2) will be utilized to study the long run effects of CIA interventions on export structure.

$$EX_i = \beta_1 EX_{i0} + \beta_2 USinfluence_i + \beta_3 \left(\frac{Y_i}{L_i}\right) + \beta_4 L_i + \gamma X_i + \theta_r + \varepsilon_i \qquad (1.2)$$

In this specification, $USinfluence_i$ represents the fraction of the Cold War period where a particular country was successfully influenced by the US. The Soviet influence variable is also measured similarly. Region fixed effects replace country fixed effects and time subscripts are removed as equation (1.2) represents a cross-sectional model. EX_{i0} represents average economic complexity or diversification at an initial period while all other variables with i subscripts represent recent five-year averages. As the available data for the ECI doesn't coincide with the US influence data, the short run analysis cannot be done with ECI as the dependent variable. Therefore, only the long run analysis represented by equation (1.2) is conducted with ECI as the dependent variable, while both equations are estimated when the Theil index is the dependent variable.

Data

The data on US influence are taken from Berger et al. (2013b). They consider instances of successful US influence to be where the CIA either installed and/or helped an incumbent leader maintain power. In their framework, US influence includes the creation and dissemination of propaganda, the provision of funds for political campaigns, the support of paramilitary operations via the provision of military aid, the coordination of coups, assassinations etc. Their data covers the Cold War period 1947-1989. According to their data, 27 countries were successfully influenced by the US 20 or more times over the 43-year period. 50 countries in my sample have experienced at least one instance of US influence over the period 1947-1989[4]. The top 10 most affected countries are highlighted in Table 1.1.

Table 1.1: The top 10 most influenced countries over the period 1947-1989

Country	US Influence	Install & Support	Support Only	Total Theil	Between Theil	Real GDP per capita ($US 2017)
Liberia	43	0	43	4.58	1.67	1,243
Saudi Arabia	43	0	43	5.24	1.7	48,196
El Salvador	43	0	43	3.05	-0.03	7,322
South Korea	41	0	41	2.45	0.17	35,980
Philippines	40	40	0	3.16	0.49	6,236
Haiti	37	0	37	5.09	1.9	1,593
Italy	36	36	0	1.58	0.05	40,090
Paraguay	36	0	36	3.84	0.08	10,675
Nicaragua	33	0	33	3.28	0.04	4,754
Dominican Republic	32	0	32	2.45	0.05	13,302

Note: Figures for real GDP per capita and the total and between Theil indices are averages for the period 2010-2014

The IMF provides data on the total Theil index for the period 1962-2014 which measures a country's level of export concentration/diversification. A key benefit of the total Theil index is that it can be broken down into the between and within Theil indices to capture the extensive and intensive margins of trade respectively. For my purposes, the between Theil index is particularly relevant as the extensive margin reflects the number of different products exported. The total Theil index is calculated as:

$$Theil_i = \frac{1}{n}\sum_{k=1}^{n}\frac{x_{ik}}{\mu} \times \ln\left(\frac{x_{ik}}{\mu}\right)$$

Where x_{it} represents the value of product k exported by country i, n is the total number of exported products and μ is average exports, $\mu = \frac{1}{n}\sum_{k=1}^{n} x_k$.

[4] I do not include Germany, Bangladesh, Pakistan and Vietnam as the data provided for those countries by Berger et al. (2013b) represent partitioned or otherwise different versions of the modern countries. Data for the Theil indices were not available to match the US influence data for these countries over the relevant period.

Notice that $Theil_i$ depends on the number of products exported (n) and the relative value of each product's exports $\left(\frac{x_{ik}}{\mu}\right)$. If country i has perfect export diversification so that it exports equal amounts of each product and so $x_{ik} = \mu$, then $Theil_i = 0$. Consequently, $Theil_i$ measures country i's level of export concentration/diversification. Low values of $Theil_i$ reflect low (high) levels of export concentration (diversification) while high values of $Theil_i$ reflect high (low) levels of export concentration (diversification). As mentioned previously, $Theil_i$ could be decomposed as follows:

$$Theil_i = Theil_{i,between} + Theil_{i,within}$$

Where:

$$Theil_{i,within} = \sum_{j=0}^{J} \frac{n_j}{n} \frac{\mu_{ij}}{\mu} \ln\left(\frac{\mu_{ij}}{\mu}\right)$$

And,

$$Theil_{i,between} = \sum_{j=1}^{J} \frac{n_j}{n} \frac{\mu_{ij}}{\mu} \left[\frac{1}{n_j} \sum_{k \in G_j}^{n} \frac{x_{ik}}{\mu_j} \times \ln\left(\frac{x_{ik}}{\mu_j}\right)\right]$$

Where the number of exported products n could be partitioned into J groups/sectors[5]. Like the total Theil index, high values of the between and within indices represent high (low) levels of export concentration (diversification). A high between index indicates a low range of products exported, while a high within index indicates a high degree of imbalance in the value of exports over the current range of exported products.

Data on export complexity comes from the Growth Lab at Harvard University which

[5] G_j represents group j.

computes the Economic Complexity Index (ECI) for the period 1995-2021. The index is based on the assumption that the products produced by a particular country reflect the knowledge capabilities of that country. The concept and calculation of the index is detailed in The Atlas of Economic Complexity by Hausmann et al. (2014). A country that produces a diverse range of products is considered to have diverse knowledge. Additionally, products that are mainly produced by countries with diverse knowledge are considered to require more complex networks and therefore embody complex knowledge. For example, oil is produced by many countries but oil producing countries tend to produce a narrow range of goods. Oil is therefore considered to embody relatively low levels of complex knowledge as the countries that produce it presumably do not possess such knowledge on account of their production of a narrow range of noncomplex goods. On the other hand, jet engines are produced by a few countries who also produce and export a wide range of goods. Jet engines are therefore considered to embody complex knowledge. Countries receive a higher score on the index the greater the relative number of 'complex' products exported with a revealed comparative advantage. The index is calculated as follows.

$$k_{c,N} = \frac{1}{k_{c,0}} \sum_{p} M_{c,p} \cdot k_{p,N-1}$$

$$k_{p,N} = \frac{1}{k_{p,0}} \sum_{c} M_{c,p} \cdot k_{c,N-1}$$

Where c and p index countries and products respectively. $M_{c,p}$ is an indicator that takes one if country c exports product p with a revealed comparative advantage equal to or greater than one. $k_{c,0}$ is the number of products that country c exports with a revealed comparative advantage (diversity), $k_{p,0}$ is the number of countries that export product p with a revealed comparative advantage (ubiquity), and N is the total number of countries. $k_{c,N}$ is therefore the average ubiquity of the products country c exports with a revealed comparative advantage while $k_{p,N}$ is average diversity of the countries that produce product p with a revealed comparative advantage. Putting $k_{p,N}$ into $k_{c,N}$ and simplifying gives:

$$k_{c,N} = \sum_{c'} \widetilde{M}_{cc'} k_{c',N-2}$$

Where,

$$\widetilde{M}_{cc'} = \sum_{p} \frac{M_{c,p} M_{c',p}}{k_{c,0} k_{p,0}}$$

Finally, the ECI is calculated as,

$$ECI = \frac{K - [K]}{stdev(K)}$$

Where K is the eigenvector of $\widetilde{M}_{cc'}$ with the second largest eigenvalue. A country with a high ECI is therefore considered to have a revealed comparative advantage in a range of products that largely embody complex knowledge. Such a country is assumed to have relatively complex productive knowledge on account of its above average exports in ‘complex’ products.

Resource abundance will be proxied by the per capita value of oil and gas production taken from Ross &Y Mahdavi (2015) who provide country level data for fossil fuel production and exports for 1932-2014. Following Berger et al. (2013b), I use the democracy indicator from Cheibub, Gandhi, & Vreeland (2010) in the panel analysis. The indicator takes one in years in which a particular country is a democracy and zero otherwise. For the cross-sectional analysis, institutional quality is proxied by the Varieties of Democracy’s (V-Dem) political corruption index which averages across 4 other indices that capture corruption at the public sector, legislative, judicial and executive levels. The index ranges from 0 (no corruption) to 1 (ubiquitous corruption). All other data is taken from the Penn World Tables which has data for

1950-2019.

Results

Table 1.2 provides evidence largely at the 10% level that US influence negatively affected export diversification. Table 1.3 shows that this negative relationship was largely along the extensive margin as similar regressions with the within Theil index as the dependent variable in Table A.1 (see Appendix) shows that US influence had no effect on export diversification at the intensive margin[6]. This suggests that US interventions reduced the range of exports in affected countries but not the relative size of exports for products that remained. Interestingly, countries falling under Russian influence did not seem to experience a similar decline in the range of their exports. As found by other studies, increases in petroleum abundance are associated with low levels of export diversification while increases in per capita income are associated with improvements in export diversity.

[6] The results in tables 1.2, 1.3 and A.1 always treat the lagged dependent variable as endogenous and sometimes treat per capita income as endogenous based on studies like Hesse (2008) and Mau (2016) who provide strong evidence that export diversification is a determinant of per capita income.

Table 1.2: GMM-system estimation of the effects of US influence on export concentration (Total Theil)

Dependent Variable:	Log of the Total Theil Index					
Variables	(1)	(2)	(3)	(4)	(5)	(6)
Lagged total Theil index	0.672*** (0.072)	0.673*** (0.071)	0.662*** (0.094)	0.700*** (0.075)	0.697*** (0.077)	0.640*** (0.092)
US influence	0.024* (0.013)	0.024* (0.012)	0.027** (0.014)	0.022* (0.012)	0.022 (0.014)	0.035** (0.017)
Per capita income	-0.075*** (0.016)	-0.074*** (0.016)	-0.045*** (0.015)	-0.068*** (0.024)	-0.070** (0.028)	-0.092** (0.045)
Population	-0.028*** (0.007)	-0.028*** (0.007)	-0.030*** (0.009)	-0.026*** (0.008)	-0.026*** (0.008)	-0.035*** (0.011)
Russian influence	-0.023 (0.019)	-0.023 (0.019)	-0.021 (0.016)	-0.021 (0.018)	-0.022 (0.017)	-0.034 (0.021)
Petro value per person	0.017*** (0.004)	0.017*** (0.004)	0.014*** (0.004)	0.016*** (0.005)	0.016*** (0.006)	0.020*** (0.007)
Democracy indicator		-0.002 (0.011)	0.015 (0.010)		-0.000 (0.021)	0.028 (0.018)
Trade openness			-0.063 (0.044)			-0.044 (0.058)
Human capital index			-0.122*** (0.045)			-0.037 (0.074)
Observations	2,983	2,983	2,602	2,983	2,983	2,602
Countries	116	116	102	116	116	102
AB AR(1)	0	0	6.46e-10	0	0	2.41e-10
Hansen	0.504	0.502	0.580	0.219	0.229	0.305

Note: Results from one step GMM-system are presented. Robust errors are given in parentheses. All specifications include country and year fixed effects. P-values for the Arellano-Bond AR(1) test for serially correlated errors along with the Hansen test of over-identifying restrictions are reported. In columns 1-3, only the lagged dependent variable is considered endogenous and instrumented by lagged values of itself while in columns 4-6, the lagged dependent variable and income per capita are both considered endogenous and instrumented by lagged values of themselves. Besides the indicators, all variables are in logs.

Table 1.3: GMM-system estimation of the effects of US influence on export concentration (Between Theil)

Dependent Variable:	Log of the Between Theil Index					
Variables	(1)	(2)	(3)	(4)	(5)	(6)
Lagged between Theil index	0.619*** (0.070)	0.619*** (0.069)	0.628*** (0.079)	0.702*** (0.061)	0.699*** (0.061)	0.707*** (0.066)
US influence	0.078*** (0.023)	0.084*** (0.024)	0.080*** (0.025)	0.061*** (0.019)	0.068*** (0.023)	0.070*** (0.022)
Per capita income	-0.060*** (0.016)	-0.068*** (0.017)	-0.016 (0.020)	-0.045 (0.028)	-0.064* (0.035)	-0.075 (0.059)
Population	-0.030*** (0.008)	-0.032*** (0.008)	-0.030*** (0.009)	-0.023*** (0.007)	-0.025*** (0.007)	-0.028*** (0.008)
Russian influence	0.035 (0.029)	0.042 (0.029)	0.019 (0.031)	0.027 (0.023)	0.035 (0.024)	-0.001 (0.030)
Petro value per person	0.015*** (0.004)	0.016*** (0.004)	0.010*** (0.004)	0.012** (0.006)	0.014** (0.006)	0.015** (0.007)
Democracy indicator		0.027 (0.016)	0.043*** (0.016)		0.034 (0.036)	0.053** (0.020)
Trade openness			-0.088* (0.048)			-0.035 (0.062)
Human capital index			-0.155*** (0.058)			0.005 (0.122)
Observations	2,981	2,981	2,600	2,981	2,981	2,600
Countries	116	116	102	116	116	102
AB AR(1)	6.85e-07	7.15e-07	1.15e-05	4.48e-07	4.60e-07	1.74e-05
Hansen	0.0264	0.0269	0.0546	0.0280	0.0374	0.116

Note: Results from one step GMM-system are presented. Robust errors are given in parentheses. All specifications include country and year fixed effects. P-values for the Arellano-Bond AR(1) test for serially correlated errors along with the Hansen test of over-identifying restrictions are reported. In columns 1-3, only the lagged dependent variable is considered endogenous and instrumented by lagged values of itself while in columns 4-6, the lagged dependent variable and income per capita are both considered endogenous and instrumented by lagged values of themselves. Besides the indicators, all variables are in logs.

There is evidence to suggest that the negative effect of US interventions on the range of goods exported by a particular country persists into the long run. Table 1.4 shows that US influence in the Cold War period is positively related to export concentration in recent times based on cross sectional analysis once export concentration in the initial period is omitted from the analysis. However, when the initial level of export diversification is considered, the significance of the US influence variable disappears. This doesn't necessarily imply that the impact of US interventions on the range of a country's exports was not long lasting since the data for the Theil index does not extend back to the entire Cold War period. It is possible that US influence before 1962 (the first year for which data on the Theil index is available) exacerbated export concentration resulting in a high average Theil index over the five-year period 1962-1966. High levels of export concentration in this latter period may have contributed to high levels of concentration in more recent times although US influence may have ended before 1962.

The impact of US influence on export sophistication is less clear. Although the US influence variable in column 3 of Table 1.5 is statistically significant, it only becomes significant after the inclusion of the human capital variable which has a significant number of missing values. Consequently, the regression in column 3 is based on a more than 50% decrease in observations[7].

[7] Similar analysis was also performed with only low-income countries, but results were not statistically significant.

Table 1.4: Export diversification and US influence cross section analysis

Dependent Variable:	Total Theil Index		Between Theil Index	
Variables	(1)	(2)	(3)	(4)
Share of US influence 1947-1989	0.123*	0.053	0.314***	0.140
	(0.074)	(0.079)	(0.112)	(0.126)
Average total Theil 1962-1966		0.419***		
		(0.113)		
Average between Theil 1962-1966				0.257**
				(0.127)
Population	-0.077***	-0.045***	-0.048***	0.000
	(0.010)	(0.015)	(0.015)	(0.026)
Income per person	-0.101***	-0.072*	-0.096**	-0.139**
	(0.025)	(0.040)	(0.038)	(0.062)
Political corruption	0.031	0.002	0.046	0.038
	(0.117)	(0.127)	(0.179)	(0.206)
Share of Russian influence 1947-1989	-0.020	0.006	-0.222	-0.274*
	(0.097)	(0.099)	(0.148)	(0.156)
Petro value per person	0.034***	0.026***	0.030***	0.027***
	(0.006)	(0.006)	(0.009)	(0.010)
Human capital adjusted capital stock per person		0.012		0.092*
		(0.034)		(0.054)
Observations	130	109	130	109
R-squared	0.605	0.647	0.250	0.308

Note: Standard errors are given in parentheses. All variables are in natural logs and represent five-year averages. Unless otherwise stated, the averages are calculated over the period 2010-2014. All specifications include continent indicators.

Table 1.5: Economic complexity and US influence cross section analysis

Dependent Variable:	Average Economic Complexity Index		
Variables	(1)	(2)	(3)
Share of US influence 1947-1989	-0.011 (0.213)	0.009 (0.164)	-0.303** (0.124)
Average economic complexity 1995-1999			0.493*** (0.102)
Population		0.096*** (0.027)	0.095*** (0.022)
Income per person		0.218*** (0.063)	0.347*** (0.070)
Political corruption		-0.691** (0.283)	0.241 (0.229)
Share of Russian influence 1947-1989		-0.098 (0.208)	-0.142 (0.162)
Petro value per person		-0.065*** (0.013)	-0.053*** (0.011)
Human capital adjusted capital stock per person			-0.064 (0.071)
Observations	106	103	47
R-squared	0.421	0.674	0.908

Note: Standard errors are given in parentheses. All variables are in natural logs and represent five-year averages. Unless otherwise stated, the averages are calculated over the period 2010-2014. All specifications include continent indicators.

Conclusion

Using GMM-system to address endogeneity, I provide evidence that US interventions to install and/or support leaders during the Cold War period reduced export diversification along the extensive margin. These results hold even after controlling for known determinants of export diversification like resource abundance. Results suggest that the negative effect on export diversification persists into the long run. The effects of US influence on export sophistication are less clear as the data doesn’t allow for a short-term dynamic analysis. The long-term cross-sectional analysis only reveals an adverse relationship in a significantly restricted sample of countries.

Unlike US influence, Russian influence during the Cold War did not have a statistically significant effect on export diversification or sophistication. This suggests fundamental differences in the interventions of both superpowers. Berger et al (2013a) finds that US influence compromised democratic institutions in affected countries. Given the communist ideology of Russian, it is unlikely that their interventions improved democratic institutions. Berger et al (2013b) find that following US interventions, government to government arrangements led to an increase in imports from the US particularly in goods in which the US had a comparative disadvantage. This channel is perhaps the likely culprit for my results. However, my results do not rule out other possible explanations. More research is needed to properly identify the mechanisms by which US interventions reduced the range of exports from affected countries and to measure the possible subsequent impact on growth and development.

CHAPTER 2

THE LOCAL EFFECTS OF UNION STRENGTH ON THE NON-PETROLEUM TRADABLE SECTOR DURING PETROLEUM BOOMS

Introduction

Country level studies have shown that resource rich countries tend to experience slower economic growth than resource poor ones[8]. This result has been attributed to many factors including worsening institutions (Ades & Di Tella, 1999; Brollo et al., 2013), the crowding out of the tradable sector (Krugman, 1987; Sachs & Warner, 1999), human capital resource misallocation (Ebeke et al., 2015) and entrepreneurial resource misallocation (Torvik, 2002). Within country studies have found that some of these outcomes are also relevant at the local level. Allcott & Keniston (2018) find that the non-resource tradable manufacturing sector across resource rich counties in the US tends to get crowded out during oil booms largely because of rising labor costs. This is by no means a straightforward or universal result, as booms seem to negatively affect employment and the number of plants in the sector, but not revenue or productivity. Several other studies highlight positive effects from resource booms at both country and local levels. For example, booms can have positive human capital effects in the presence of weak institutions where there are clear mechanisms for the distribution and spending of rents, and transfers of rent are relatively modest (Aguero et al., 2021). Bartik et al. (2019) estimate significant increases in welfare for a subset of the areas in the US that have experienced a fracking boom. This shows that results can be heterogeneous with respect to specific environments and outcome variables. It is also suggestive of heterogeneity as it relates to

[8] See Sachs & Warner (2001) for a summary.

industries and/or sectors[9]. In a country level study, James (2014) does not find statistical support for a negative growth effect in non-resource or service sectors in resource dependent countries. In another country level study that examines the effect of oil discoveries on GDP per capita, Smith (2015) finds that results also vary based on country classification[10].

Based on the degree of heterogeneity in results, it seems logical that further research on the effects of natural resource abundance and dependency should focus more on understanding the phenomenon at a granular level. This would allow policymakers to better understand their unique scenario and develop policies that are better targeted and relevant. In the US context, one prospective granular level of analysis has to do with how the strength of labor unions interacts with resource booms to potentially alter employment effects across sectors and industries. There is a huge debate on whether unions are a net benefit for workers and the wider society. Those against unions point out that unions increase operating costs and reduce profitability thereby disadvantaging firms on the global stage (Hirsch, 2004; Lee & Mas, 2012). They also posit that unions reduce employment, particularly for vulnerable groups like the young and low skilled workers. Advocates for unions argue that unions play a critical role by empowering workers, thus leading to improvements in working conditions, job security and fairer remuneration. They point to studies that link the increase in income inequality in countries like the US and UK to the weakening of unions (Card, Lemieux, & Riddell, 2004). More recently, they have highlighted studies that suggest unions provide spillover benefits to workers at firms that are not union

[9] Allcott & Keniston (2018) find that oil booms positively impact employment, revenue, investment and plant numbers in manufacturing as a whole and non-resource non-tradable manufacturing in oil abundant US counties. Micheals (2010) also finds that resource wealth does not crowd out the overall manufacturing sector in southern US counties.

[10] Smith (2015) classifies countries as OECD or non-OECD.

members or covered by a collective bargaining agreement (Taschereau-Dumouchel, 2020). The threat of reduced profits because of future unionization of its workers may lead some firms to pay higher wages, improve working conditions and offer benefits that they otherwise would not.

Given the significant and widespread impacts of unions that are recognized by both sides of the aisle, it is plausible to conceive that they must have some effect on the response of employment to petroleum booms which are widely recognized to put upward pressure on wages. Since the non-resource tradable sector is most likely to be negatively affected by resource booms, the case surrounding this sector is perhaps most interesting. It seems likely that a strong union presence could either mitigate the negative employment effects in the sector caused by a resource boom or exacerbate them. If non-resource tradable firms are unionized, then it may be harder to lay off some workers, and employment may be preserved, given rising wages and other costs resulting from a resource boom. It is also possible that strong unions depress as opposed to preserve employment in the non-resource tradable sector beyond what would typically be expected in their absence. Since unionized firms are likely to have higher costs and therefore lower profit margins, a positive wage shock may push them towards losses and force them to downsize. Additionally, if there are difficulties in downsizing the workforce and resisting demands for wage increases, unionized firms may be forced to close and relocate to areas where unions are relatively weak. If this is the case, one could expect to see a county with a unionized non-resource tradable sector experience larger declines in employment following a resource boom compared with a similar county where workers are not unionized.

This study brings together aspects of the resource curse literature and the literature on the pros and cons of unionization. Unions have been shown to have varying effects on establishment survival and employment at the subnational level in the US (Boal & Pencavel, 1994; Freeman &

Kleiner, 1994; DiNardo & Lee, 2004; Wang & Young 2022). Understanding the nexus between resource abundance, booms, employment, and union strength is therefore important for authorities as the results could potentially be severe. To my knowledge, the only paper that studies a similar issue is Sances & You (2017) who look at how union membership among local government workers in the US affected spending decisions following shale gas booms. Whether union strength helps or hurts employment in the tradable sector during resource booms is still an open question. This study sheds light on this question by comparing the response of county level employment in the non-petroleum tradable sector (NPTS) to petroleum booms in states with relatively strong unions to border counties in states with weak unions. This strategy minimizes the risks posed by omitted variable bias as counties next to each other are likely to have similar characteristics.

My results reveal that within a relatively small geographic radius, union strength does not seem to have a distinct identifiable impact on employment following booms. There is some evidence to suggest that these results point to the existence of spillover effects where employment in weak union locations 'benefit' from their proximity to strong unions (or vice versa). Consequently, the response of employment to petroleum shocks is similar in both groups. As proximity to strong unions decreases, the response begins to diverge.

Methodology

This study seeks to identify the effect union strength has on NPTS employment in the US during resource booms. For purposes of this investigation, union strength is measured by the state level share of union members in employed workers and the share of employed workers covered by a collective bargaining agreement. Union strength will also be proxied by the presence/absence of state level right to work (RTW) laws following Holmes (1998) and

Feigenbaum et al. (2018). RTW laws are generally considered to weaken unions as they allow workers in a unionized firm to opt out of formally joining the union and thereby not pay union dues even if the worker benefits from the union's efforts. More than that, RTW laws are generally passed by states with other policies that are relatively unfriendly to trade unions[11]. The absence of RTW laws is therefore a good proxy for union strength. There is general consensus in the literature that RTW laws weaken unions via decreasing contemporary and new unionization rates (Eren & Ozbeklik, 2016; Ellwood & Fine, 1987; Dinlersoz & Hernandez-Murillo, 2002)[12]. A review of RTW laws across states by Feigenbaum et al. (2018) concludes that they are legally similar. RTW laws can also be considered exogenous at the county level since they are essentially imposed at the state level.

The desired specification merges the approach of Allcott & Keniston (2018) with Feigenbaum et al. (2018). The empirical strategy makes use of county level employment data to compare the impact on employment in the non-resource tradable sector across resource abundant counties that vary with respect to trade union strength. Given that data on union strength is only available at the state level, the empirical approach limits the sample to resource abundant counties that share a border across states. County pairs are grouped if they are petroleum abundant and share a cross-state border. County pair-fixed effects are utilized so that the response to an oil boom in one petroleum abundant county is compared to the response in an adjacent county in another state where the strength of unions is different. An important benefit of this approach is that it limits the differences between counties in the analysis as counties that

[11] Holmes (1998) uses RTW laws as a proxy for relatively weak union / pro-business state policy.

[12] See Devinatz (2011) and Moore (1998) for a review of the empirical literature on the effects of RTW laws.

share a border are likely to be more similar than counties far removed from each other. Therefore, this approach fosters more of an apples-to-apples comparison and reduces the need for a range of controls to isolate the effects of union strength on the employment outcome being studied amid an oil boom. Another key feature of the approach is that a petroleum abundant county from one state that shares a border with petroleum abundant counties from a different state (or states) enters the data as multiple county observations. For example, San Juan County in Utah is petroleum abundant and shares borders with five petroleum abundant counties in Colorado and one each in New Mexico and Arizona. Consequently, for each year that data is available, San Juan enters as seven separate observations. The desired specification is reflected in equation (2.1).

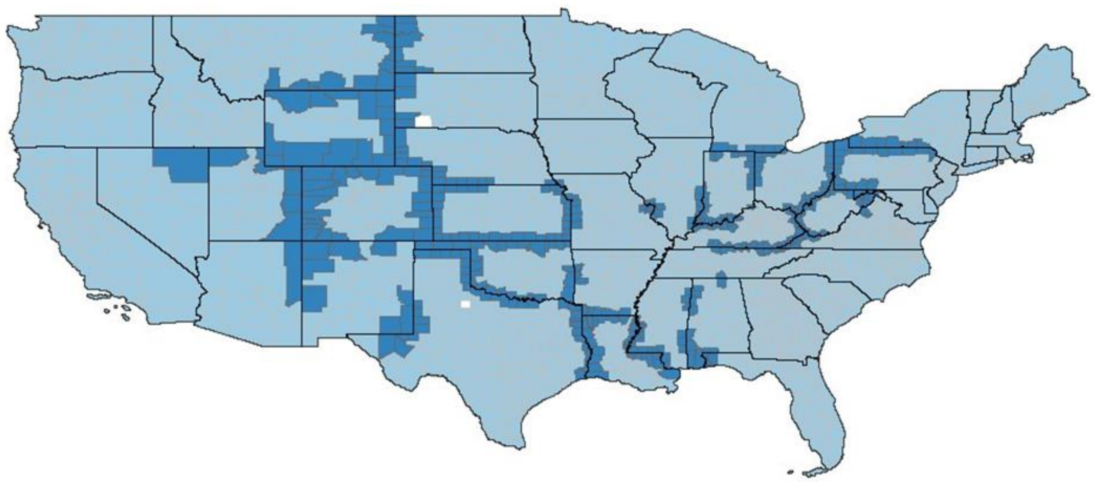
$$Y_{csgt} = \alpha + \beta U_{st} + \delta(\Delta \ln EMP_t \times U_{st}) + \tau_{gt} + \theta_c + \varepsilon_{csgt} \qquad (2.1)$$

Y_{csgt} represents either the change in the log of NPTS employment or the change in the log of its share of employment in county c in state s in group g in year t. U_{st} is a measure of union strength as proxied by either the share of unionized workers in employed workers, the share of employed workers covered by a collective bargaining agreement or the presence of RTW laws. $\Delta \ln EMP_t$ represents the change in the log of petroleum sector employment nationally and is meant to capture petroleum booms in the US. In this specification, the coefficient of interest δ is driven by within county variation in response to oil booms in counties with relatively strong unions as compared to variation in other bordering resource abundant counties with weaker unions. If $\delta < 0$ then strong unions worsen the effect of resource booms on NPTS employment. This interpretation is true when union strength is measured by the share of unionized workers or workers covered by a collective bargaining agreement. The opposite is true when union strength is proxied by the absence of RTW laws. When union strength is measured by unionized or covered workers, τ_{gt} represents dummies that take one for petroleum abundant county pairs that share a cross-state border. These year-pair fixed effects imply that for a county that borders two counties in another state, the former county enters the data as two separate observations. If there is a county that borders four counties in another state, then this county enters as four observations. When union strength is proxied by RTW laws, τ_{gt} represents dummies that take one for petroleum abundant county pairs that share a border each side of states that differ with respect to their RTW status at some point over the sample period. As before, counties may enter the data multiple times if they share a border with multiple counties across states where the RTW status of county pairs differs at some point. Finally, θ_c represents county fixed effects that control for fixed differences in county characteristics.

Since the county level dependent variables are restricted to NPTS outcomes, mechanisms are needed to classify counties as petroleum abundant and sectors as non-petroleum and tradable. In the spirit of Michaels (2010), a county is considered petroleum abundant if it lies above at least one oil/gas field. Alternatively, as a robustness check, petroleum abundant counties are limited to counties containing all or a section of oil or gas fields in the top one hundred such fields in 2013. As it relates to the classification of industries, I use the classification done by Barkai & Karger (2020) who distinguish between tradable and non-tradable industries at the 6-digit level of the North American Industry Classification System (NAICS) based on the share of the population living in close proximity to industry establishments. In their framework, tradable industries are those that serve a geographic radius relatively far from establishment locations, while non-tradable industries serve a relatively nearby geographic radius.

Using Input-Output tables for 1987 from the Bureau of Economic Analysis, Allcott & Keniston (2018) sum the share of output purchased directly or indirectly by the petroleum sector for each industry. They consider an industry as linked (upstream) to the petroleum sector if the share is larger than 0.1%. Conversely, an industry is considered linked (downstream) if its purchases (direct and indirect) from the petroleum sector exceed 0.1%. Otherwise, an industry is considered unlinked from the petroleum sector. I utilize a similar approach, but I combine the upstream and downstream shares and use 1% and 2% thresholds to classify industries as petroleum or non-petroleum linked. This process is described in more detail in the data section.

Figure 2.1: Cross state border paired petroleum abundant counties



Note: The dark blue areas are petroleum abundant counties in 2016 that share a border across states.

Figure 2.1 shows the petroleum abundant county pairs that enter the analysis based on lying above at least one oil/gas field. Most counties included in the analysis come from the middle section of lower mainland USA. Although there are 34 states in lower mainland US that are classified as petroleum abundant; California, Iowa, Oregon and Washington do not enter the analysis because none of their petroleum abundant counties share a border with another petroleum abundant county from another state.

Data

Employment Data

The US Census Bureau's County Business Patterns (CBP) compiles county level data on employment by industry during the week of March 12, number of establishments and first quarter and annual payroll by industry[13]. This data is collected via administrative records and surveys of establishments. Before 2017, the CBP suppressed county-industry payroll data and reported employment data in ranges when the number of establishments in a county-industry pair was less than 3. This is also done to otherwise prevent the disclosure of data linked to any individual establishment or when the data did not meet the necessary quality standards for publication. Since 2017, no data has been published for county-industry pairs with less than 3 establishments.

This suppression is widespread and compromises the effective use of the CBP data to conduct analysis. Data suppression has a significant effect on the quantity of data published. Eckert et al. (2021) note that more than half of the county-industry cells in the CBP are suppressed. Even with the employment ranges provided for these suppressed cells, challenges remain as the range can be very wide. For the twelve employment range categories defined, the upper bound represents an increase over the lower bound of at least 99%. Lower bounds range from 0 to 100,000. This imprecision for much of the employment data in the CBP significantly limits its usefulness in empirical analysis. Added to this are complications posed by changing industry classification frameworks. For example, prior to 1998, industry level data in the CBP is

[13] The CBP does not contain data for the following industries: Crop and Animal Production; Rail Transportation; Postal Service; Pension, Health, Welfare, and Other Insurance Funds; Trusts, Estates, and Agency Accounts; Offices of Notaries; Private Households; and Public Administration.

organized according to the Standard Industrial Classification (SIC). From 1998 however, the industry classification system utilized is the North American Industry Classification System (NAICS). Significant methodological differences in the two systems make it difficult to compare data for certain industries before and after the transition. Consequently, instead of raw published Census Bureau CBP data, I use data from Eckert et al. (2021) who complement the CBP by imputing suppressed employment data and synthesizing industry classifications across years to reflect one standard framework[14].

The industry codes used by the CBP (SIC and NAICS) are hierarchical in nature. For example, employment data at the 6-digit industry level in the NAICS is also contained through aggregation at the 5-digit, 4-digit etc. levels. Suppression is more likely at the more defined industry level (6-digit). For each county, Eckert et al. (2021) use data for higher level industry classification codes, and state and national level data to impute missing values. The values are imputed by solving a linear programming problem where they minimize the distance of the imputed value from the midpoint of the relevant range subject to aggregation constraints at higher level industry/sector codes and state and national levels. Some challenges with the data are still present resulting from the transition from SIC to NAICS in 1998 and the change of policy with respect to publishing data for industries with fewer than 3 establishments in 2017. Consequently, although Eckert et al. (2021) provide a county level panel for the period 1975-2016, as a robustness check I limit my analysis to data for the period 1998-2016.

[14] Their data is based on the 2012 NAICS.

Industry Classifications

To classify industries as tradable I make use of the work done by Barkai & Karger (2020) who use 2007 NAICS to classify industries at the 6-digit level as tradable, non-tradable or mixed. They define $FRACPOP(R,J)$ as the fraction of the US population living within R miles of an establishment in industry J. $CUTOFF(R)$ is the cutoff proportion of the population for radius R. The geographic radius served by industry J is the minimum value of R that satisfies $FRACPOP(R,J) > CUTOFF(R)$. Therefore, if the cutoff is determined as 50% of the US population and 50% of the population lives within 100 miles of industry J, then industry J serves a geographic radius of just over 100 miles. Notice that as expected, a tradable industry will serve a larger geographic radius than a non-tradable industry. Barkai & Karger (2020) designate an industry as non-tradable if its geographic radius served is at most 50 miles. They kindly provided the classification data resulting from their analysis which was used to identify non-tradable industries.

To distinguish between petroleum and non-petroleum industries, I utilize Input-Output tables for 2017 from the US Bureau of Economic Analysis. I calculate the percentage of an industry's inputs and sales coming from and going cumulatively to oil and gas extraction and the drilling of oil and gas wells. An industry is considered a non-petroleum industry if the average share of inputs and sales attributed to the petroleum industry is less than either 1% or 2% and both shares are less than 1% or 2%[15].

Eckert et al. (2021) are not always able to impute employment data at the 6-digit level. This is particularly true prior to 1998 when the SIC system was used to classified industries. In

[15] In the main analysis I use 1% as the cutoff. The 2% cutoff is used as a robustness check.

such cases they impute data at higher levels of classification like the 4 or 2-digit level. Consequently, higher level industry/sector data does not represent aggregates as in the raw CBP data. Instead, higher level industry and sector employment figures must be calculated. For example, 2-digit sector totals can be calculated by aggregating employment data at the 2-digit to 6-digit levels. This means that the methods described above by which industries are classified as tradable and non-petroleum misses some industries as they only capture industries at the 6-digit level. To utilize all the data, I categorize a higher-level industry/sector as tradable only if all its sub-industries are classified as tradable. The same approach is used for nonpetroleum designations. If one sub-industry is not classified as tradable and non-petroleum, the higher-level data is omitted from the calculation of tradable non-petroleum employment[16]. This approach is not without limitations as it assumes that employment recorded at a higher-level industry/sector classification must represent employment for a non-petroleum tradable industry if all identified sub-industries share the same classification. The sectors that are classified as non-petroleum tradable and therefore cover a significant share of the industries included in the analysis are listed in Table 2.1.

[16] A few manufacturing sectors are categorized as non-petroleum tradable where a small fraction of marginal industries does not meet the criteria.

Table 2.1: Sectors with all or mostly non-petroleum tradable industries[17]

2012 NAICS 3-digit code	Sector Name
311	Food manufacturing
312	Beverage and tobacco product manufacturing
313	Textile mills
315	Apparel manufacturing
316	Leather and allied product manufacturing
322	Paper manufacturing
334	Computer and electronic product manufacturing
335	Electrical equipment, appliance, and component manufacturing
336	Transportation equipment manufacturing
483	Water transportation
525	Funds, trusts, and other financial vehicles

Trade Union Data

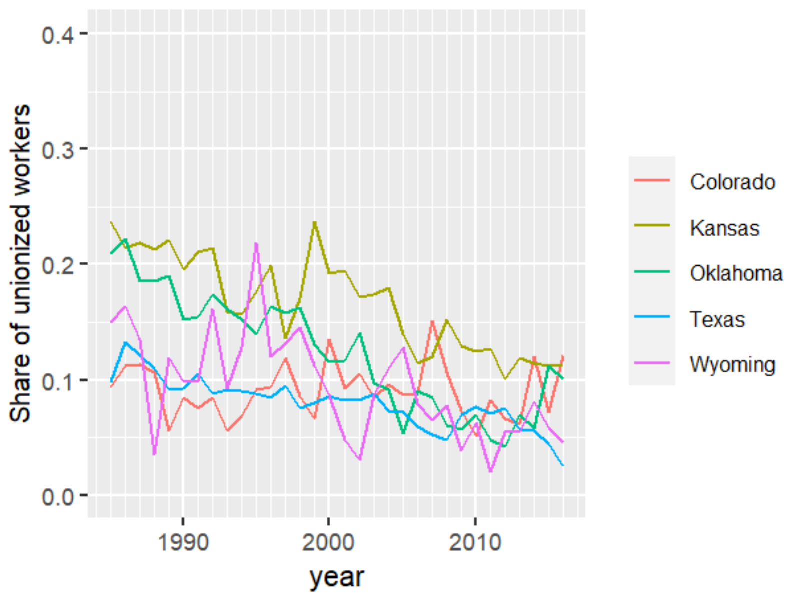
Hirsch, Macpherson & Even (2024) utilize data from the US Current Population Surveys to generate estimates for the percentage of unionized workers in employed workers, the percentage of workers covered by a collective bargaining agreement and gaps in wages between unionized and nonunionized workers. They provide this data at the website unionstats.com. As a proxy for union strength, I use their estimates for union membership and the coverage of collective bargaining agreements by state and sector. Data for these metrics are available by industry and at the national but not state level. This makes it impossible to estimate state level union strength in the NPTS. Consequently, I utilize data for the next best alternative sector, namely the private manufacturing sector.

Rates of unionization and coverage across states are highly correlated and show a general downward trend over the period 1985-2016 as shown in Figure 2.2. However, Macpherson &

[17] The analysis categorizes industries as non-petroleum tradable and then aggregates their employment figures to derive an estimate for the non-petroleum tradable sector. Consequently, the industries included in the analysis do not only come from the sectors listed here.

Hirsch (2023) show that the wage gap between unionized and nonunion workers, adjusted for worker and job features, is consistently above zero indicating that unionized workers on average earn more than comparable nonunion workers.

Figure 2.2: Share of union workers in employed workers in private manufacturing for select States



Source: Hirsch, Macpherson, & Even (2024)

Other County and National Level Data

Data on petroleum producing counties is taken from the US Energy Information Administration's (EIA) 2015 Oil and Gas Field Code Master List[18]. The list contains all oil and gas fields in the US, the counties in which they are located and the year they were discovered.

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[18] https://www.eia.gov/naturalgas/fieldcode/archive/2015/fcml.php

This information is used to code an indicator variable that takes one for counties that contain at least one oil or gas field in the years including and following the year of discovery of the county's earliest discovered field. I also use the EIA's "Top 100 U.S. Oil and Gas Fields" to code a similar indicator variable for counties that lie above top 100 oil or gas fields as of 2013[19].

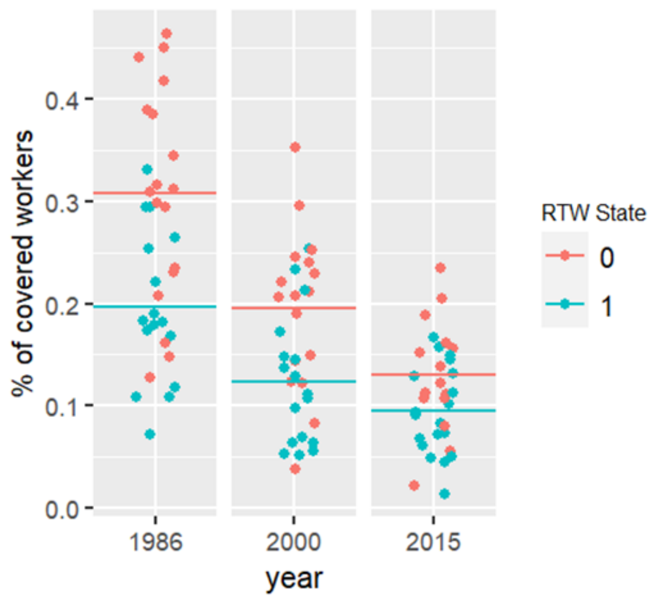
The US Census Bureau provides a list of each county in the US, the state it belongs to and the counties with which it shares a border. The data is presented such that each row represents a county border pair. As such, a county may span multiple rows based on the number of counties with which it shares a border. This data is used to generate a group ID that takes a unique number for each pair of counties sharing a border.

Data on the year a state enacted RTW laws is taken from the website of the National Conference of State Legislatures[20], while national level data on employment in the petroleum sector comes from the US Bureau of Labor Statistics. Figure 2.3 shows that although the percentage of covered workers varies across states within RTW groups, there is a clear general association between RTW status and union coverage (and also union membership). RTW status seems to capture union strength but in a different way to the percentage of covered and unionized workers.

[19] https://www.eia.gov/naturalgas/crudeoilreserves/top100/

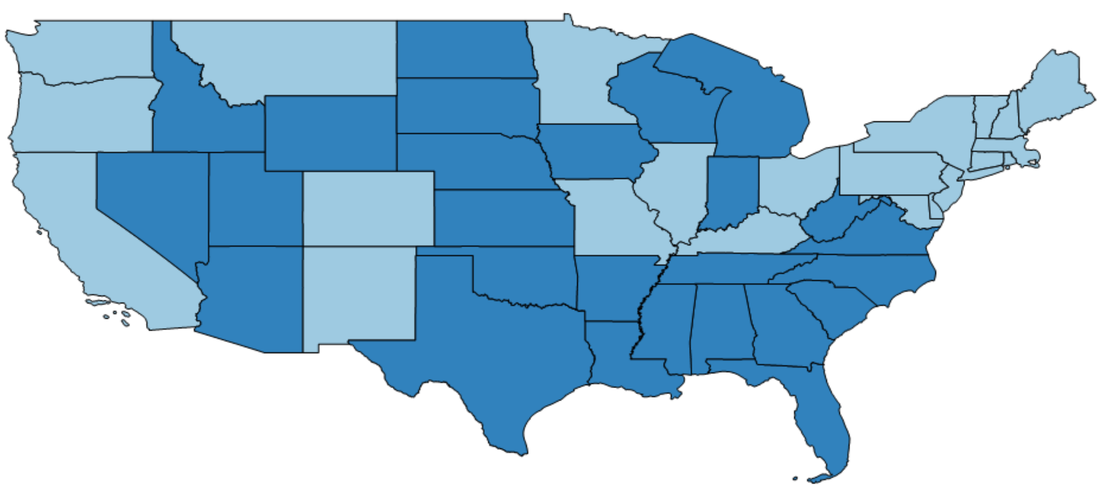
[20] https://www.ncsl.org/

Figure 2.3: Share of workers covered by a collective bargaining agreement by state based on RTW status



Note: Horizontal lines represent group means

Figure 2.4: RTW states in 2016



Note: The dark blue areas are states with RTW laws in place in 2016. States that implemented RTW laws during the sample period are Texas in 1993, Oklahoma in 2001, Michigan and Indiana in 2012, Wisconsin in 2015 and West Virginia in 2016.

Results

Estimation of equation (2.1) reveals that regardless of how union strength is measured, it does not appear to have any effect on the extent to which county level NPTS employment is affected by nationwide petroleum booms over the periods 1985-2016. In Table 2.2, union strength is measured by the percentage of workers covered by a collective bargaining agreement, while in Table 2.3 it is proxied by the absence of RTW laws. None of the coefficients are statistically significant in either table. This is true when a petroleum abundant county is defined as one with all or part of any oil or gas field above it as shown in Panel A, and also when it is defined as a one with all or part of a top 100 oil or gas field as in Panel B. Similar results are obtained when utilizing the share of workers belonging to unions as the measure of union strength, and regardless of the union strength measure when the sample is restricted to the period 1998-2016 which provides a more consistent classification of employment data from the CBP (see the Appendix for these results). Based on the findings of Allcott & Keniston (2018) and others, these results suggest that the negative effect on employment in the NPTS during petroleum booms is neither exacerbated nor mitigated by the strength of labor unions.

Table 2.2: The Effect of Union Impact on the Effect of Petroleum Sector Booms on the NPTS in Petroleum Abundant Counties in the US

Dependent Variables:	Change in the Log of Nonpetroleum Tradable Sector Employment		Change in the Log of Nonpetroleum Tradable Sector Employment Share	
Variables	(1)	(2)	(3)	(4)
Panel A				
% of workers covered by a collective bargaining agreement by state	0.0688 (0.0864)	0.140 (0.216)	0.0796 (0.0849)	0.127 (0.210)
Change in national petroleum employment * % of workers covered by a collective bargaining agreement	0.788 (1.728)	0.380 (1.762)	1.381 (1.747)	1.017 (1.760)
Observations	24,310	24,310	24,310	24,310
Prob > F	0.7306	0.7972	0.6249	0.7205
Adjusted R-squared	0.0704	0.0467	0.071	0.0462
R-squared	0.535	0.540	0.536	0.539
Panel B				
% of workers covered by a collective bargaining agreement by state	0.212 (0.371)	0.220 (0.874)	0.217 (0.338)	0.0633 (0.772)
Change in national petroleum employment * % of workers covered by a collective bargaining agreement	5.247 (8.223)	5.204 (8.764)	6.751 (7.834)	6.529 (8.381)
Observations	1,710	1,710	1,710	1,710
Prob > F	0.8049	0.6162	0.5094	0.3563
Adjusted R-squared	0.285	0.2558	0.287	0.2597
R-squared	0.643	0.647	0.644	0.649
Pair-Year Fixed Effects	Yes	Yes	Yes	Yes
County Fixed Effects	No	Yes	No	Yes

Note: Standard errors clustered by state are given in parentheses. The analysis is based on the period 1985-2016 for petroleum abundant county pairs that share a state border. In panel A, the sample is limited to counties that lie above an oil or gas field, while in panel B it is limited to counties that lie above a top 100 oil or gas field in 2013.

Table 2.3: The Effect of Right to Work Laws on the Impact of Petroleum Sector Booms on the NPTS in Petroleum Abundant Counties in the US

Dependent Variables:	Change in the Log of Nonpetroleum Tradable Sector Employment		Change in the Log of Nonpetroleum Tradable Sector Employment Share	
Variables	(1)	(2)	(3)	(4)
Panel A				
RTW county indicator	0.00110	-0.0220	-0.000526	-0.0306
	(0.00407)	(0.0259)	(0.00429)	(0.0264)
Change in national petroleum employment * RTW County Indicator	0.0460	0.0671	-0.0221	-0.0128
	(0.173)	(0.186)	(0.183)	(0.194)
Observations	16,842	16,842	16,842	16,842
Prob > F	0.939	0.698	0.989	0.441
Adjusted R-squared	0.108	0.0871	0.110	0.0875
R-squared	0.554	0.559	0.555	0.560
Panel B				
RTW county indicator	-0.00371	-0.0133	-0.00406	-0.00715
	(0.00407)	(0.0464)	(0.00386)	(0.0446)
Change in national petroleum employment * RTW County Indicator	-0.412	-0.427	-0.565	-0.556
	(0.447)	(0.469)	(0.431)	(0.462)
Observations	1,710	1,710	1,710	1,710
Prob > F	0.494	0.561	0.435	0.473
Adjusted R-squared	0.285	0.256	0.287	0.259
R-squared	0.643	0.647	0.644	0.649
County Pair-Year Fixed Effects	Yes	Yes	Yes	Yes
County Fixed Effects	No	Yes	No	Yes

Note: Standard errors clustered by state are given in parentheses. The analysis is based on the period 1985-2016 for petroleum abundant county pairs that share a state border where RTW status differs at some point over the period. In panel A, the sample is limited to counties that lie above an oil or gas field, while in panel B it is limited to counties that lie above a top 100 oil or gas field in 2013.

Discussion of Results

The results have several possible explanations. The first and most obvious is that union strength has no effect on the response of wages in the NPTS to oil shocks and hence on how employment is affected. Perhaps the relationship has broken down in recent years. After all, Allcott & Keniston (2018) perform their analysis over the period 1960 to 2011, while the sample period analyzed here is 1985 to 2016. However, if there are spillover effects, it is likely that the lack of statistical significance in the desired specification is still consistent with a role for union strength.

Wages and employment in state border counties may respond similarly to petroleum booms regardless of differences in union strength. For example, wages in counties with strong trade unions may be less volatile (Champagne & Kurmann, 2013). Workers in nearby counties with weaker unions may also ‘benefit’ from this reduction in wage volatility which translates into less impact on employment in the NPTS from petroleum shocks. In another scenario, wages in counties with strong trade unions and those nearby may be higher than those of comparable workers elsewhere. In this setting, even if the wages of workers in and close to locations with strong unions are similarly volatile to comparable workers in areas where unions are weak, the wage premium may result in different impacts on employment.

Suppose there are two firms that produce the same tradable product. Both firms are price takers and identical in every way except that firm A is unionized or close to other unionized firms and therefore pays a higher wage rate than firm B which is not unionized and far from other unionized firms. A petroleum boom causes wages to rise for both firms. Firm B, and nearby firms, on account of their lower wages, have a higher profit margin than firm A and its neighbors. Firm B and Co are therefore better placed to absorb the shock. Firm B and Co may consider the shock transitory and as such may choose to retain all or most of their workers even if it means that employment of labor is temporarily suboptimal. On the other hand, firm A and Co’s lower profit margin means that any increase in wages takes them close to or into loss-making territory. Given their reduced ability to absorb the shock, Firm A and Co are forced to decrease their complement of workers. Since firm A and nearby firms (some of which are not unionized) pay a premium wage, the impact of the boom is similar on NPTS employment in that location. This includes areas where unions are strong and nearby areas where unions are not as strong. Strong unions have a spillover effect that among other things, may result from the threat of unionization. Therefore, any analysis that involves comparison of nearby counties that differ with respect to union strength will lead to statistically insignificant estimates as in Tables 2.2 and 2.3. However, analysis of locations that differ with respect to union strength and are sufficiently far removed from each other (like Firm A and B) would perhaps reveal a relationship between union strength and the effect of petroleum booms on NPTS employment.

There is evidence in the literature that the threat of unionization which leads to lower profits, may cause some firms/establishments to adopt wage and employment strategies that are suboptimal and somewhat close to those of unionized firms in an effort to resist unionization attempts (Fortin, Lemieux, & Lloyd, 2021). To test this hypothesis in the context of petroleum booms, I estimate equation (2.2) below for petroleum abundant counties.

$$Y_{cst} = \alpha + \delta(\Delta \ln EMP_t \times RTW\_Prox_{st}) + \beta_1 RTW\_Prox_{st} + \beta_2 \Delta \ln EMP_t + \beta_3 C_{cst} + \theta_c + \gamma_t + \varepsilon_{cst} \tag{2.2}$$

In this specification, I control for county level population and per capita personal income. Also included are county fixed effects and time fixed effects in some specifications[21]. RTW_Prox_{st} is an indicator that takes one if a county is in a state that has implemented RTW laws or borders such a state. Its introduction assumes that if strong unions not only affect firms directly but also indirectly via the union threat, then the weakening of unions will also have a direct and indirect effect on firms in close proximity. If $\delta < 0$ and is statistically significant, then

[21] When time fixed effects are included, $\Delta \ln EMP_t$ is omitted.

proximity matters, and weak unions negatively affect the response of NPTS employment to petroleum booms. If $\delta > 0$, then weak unions mitigate the effects of booms on employment in the NPTS. Results of equation (2.2) are shown in Table 2.4.

Table 2.4: The Spillover Effects of Right to Work Laws on the Impact of Petroleum Sector Booms on the NPTS in Top Petroleum Abundant Counties in the US

Dependent Variables:	Log of Nonpetroleum Tradable Sector Employment Share			
Variables	(1)	(2)	(3)	(4)
Change in national petroleum employment * RTW Proximity Indicator	0.0687*	0.0455*	0.0765**	0.0261
	(0.0359)	(0.0223)	(0.0299)	(0.0181)
RTW Proximity Indicator	0.0151*	0.0183**	-0.00564	0.00305
	(0.00792)	(0.00678)	(0.00628)	(0.00744)
Change in national petroleum employment	-0.0576		-0.0667*	
	(0.0351)		(0.0361)	
Log county population	-0.0155	-0.000216	0.00255	0.0191
	(0.0263)	(0.0243)	(0.0211)	(0.0209)
Log per capita county personal income	-0.0547***	0.0316**	-0.0572***	0.0125
	(0.0113)	(0.0129)	(0.00954)	(0.0105)
Observations	6,689	6,689	4,257	4,257
R-squared	0.801	0.820	0.856	0.868
County Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	No	Yes	No	Yes
Period	1985-2016		1998-2016	

Note: Standard errors clustered by state are given in parentheses. The sample is limited to counties that lie above a top 100 oil or gas field in 2013.

The results provide some evidence that proximity to strong/weak unions matters in the relative response of employment in the NPTS to petroleum booms. The positive and significant interaction term suggest that NPTS employment in counties in states with weak unions (as measured by the presence of RTW laws) and counties that border such states are less affected by petroleum shocks. However, this result is only observed with the log of the share of NPTS employment as the dependent variable and when petroleum abundant counties are defined by the presence of a top 100 oil or gas field. This may imply that rising costs because of petroleum booms leads to a disproportionate rise in wages in the NPTS in locations where relatively strong unions exist or are sufficiently close by. This disproportionate rise in costs may result in a higher degree of layoffs in these locations as compared to locations where the union weakening effects of RTW laws are felt. However, this interpretation is contrary to the results of previous studies that find that although unions contribute to positive wage premiums for their workers, they also reduce wage volatility (Champagne & Kurmann, 2013).

Alternatively, even if the response of wages isn't disproportional, locations with unions tend to have higher wages. Therefore, the results may reflect a situation where any increase in wages that are already relatively high has a significant negative impact on profits which leads firms to cut costs by letting some workers go. However, it is important to consider that union strength as measured by the share of workers that are either union members or covered by a collective bargaining agreement has been in general decline over the period. Consequently, the results may not necessarily indicate that relatively strong unions are bad for employment in the face of petroleum booms. Instead, they may be indicative of a general decline in the ability of unions to preserve job security for workers following price shocks in an environment where wages are relatively high. Furthermore, the results are far from conclusive across a variety of specifications. Therefore, other explanations cannot be ruled out.

Wang & Young (2022) find that following successful elections to join a union at one establishment, firms may shift some workers to other establishments. Consequently, adjustments to increased union strength may take place at the establishment or firm level and not show up at the sectoral level. Therefore, when petroleum booms occur, there is little discernible difference between the impact on employment in the NPTS between counties with strong and weak unions as micro level adjustments have already been made in response to increased union strength. The lack of a significant change in employment at the sectoral level may therefore mask the effects of the boom.

Conclusion

Using county pair fixed effects, I compare the impact on employment in the non-petroleum tradable sector of petroleum abundant counties from nationwide petroleum booms across counties that share a cross-state border and differ with respect to union strength. I find that union strength does not affect the response of adjacent counties to oil booms. However, I do find evidence of a role for trade union strength when comparing counties further away from each other. My results are consistent with the literature on trade union spillover effects where nonunionized firms pay wages comparable to nearby unionized firms to reduce the incentive for its workers to form or join a union.

CHAPTER 3

THE EFFECT OF RESOURCE BOOMS ON STUDENT PERFORMANCE AT THE SECONDARY SCHOOL LEVEL IN THE CARIBBEAN

Introduction

Previous research has documented the negative effects resource abundance can have on economic outcomes. Resource wealth has been linked to the erosion of the tradable sector, exacerbation of the business cycle, and declines in productivity and long-term growth (Sachs & Warner, 2001; Harding & Venables, 2016). Resource booms have also been linked to increases in corruption, conflict and worsening institutional quality all of which have been shown to affect economic performance (Ades & Di Tella, 1999; Brollo et al., 2013). Further research has found heterogeneous effects of oil wealth on economic outcomes. For example, countries with high institutional quality, functioning democracies etc., are less likely to be negatively affected by resource wealth (Mehlum, Moene, & Torvik, 2006).

However, despite the abundance of research on the effects of resources on economic indicators, there are relatively few studies on the effects on education. Most of the research has assumed that the effect of resource wealth on social outcomes like education depends on whether oil wealth promotes or undermines economic growth. As such, the extent of the impact is assumed to depend on how education funding is affected. For example, results from an empirical study suggest that resource dependence does lead to reductions in public spending on education (Cockx & Francken, 2016). This approach views any impact of resource booms on education as an indirect phenomenon mainly via a financial channel. It largely ignores the possibility for resource booms to alter the set of incentives available to students which may affect their performance. If incentives are considered, it is usually in the context of decisions by individuals to remain or drop out of the education system. For example, Edwards (2016) finds that resource dependent countries had lower average levels of years of schooling and higher rates of uneducated individuals. Chuan (2022) finds that increasing oil and gas jobs decreases college enrolment for men in the US. Cascio & Narayan (2022) obtain similar results for high schoolers in the US. This suggests that resource wealth may create incentives for individuals to choose jobs over formal education. This is perhaps expected if oil booms are accompanied by well-paying low-skilled jobs (Mosquera, 2022).

In one of the few studies that directly examines the effect of oil dependence on the incentives faced by individuals who remain in the education system, oil dependence is found to orient tertiary level students towards degrees that increase potential for rent extraction as opposed to generating new output (Ebeke, Omgba, & Laajaj, 2015). Thus, there is empirical support for the notion that resource dependence alters the incentive structure and decision making of the consumers of education.

Despite the multitude of evidence that links resource abundance and shocks to a deterioration in education outcomes, there is evidence that the reverse is possible. Although it does not address the incentive issue, an important study by Aguero et al. (2021) suggests that resource booms could positively affect test scores even in the face of poor institutions. Their results show that a novel windfall redistribution system in Peru generates improvements in test scores from rent transfers. However, this relationship is found to be non-monotonic with scores negatively impacted by transfers above a certain threshold. The main channels are found to be education expenditure, infrastructure and household health which also exhibit non-monotonic relationships with resource transfers.

In this paper I contribute to the literature by analyzing the impact of resource booms on the incentives faced by individuals who remain in the education system. I examine the effects of resource wealth on educational performance. Exploiting variation in resource wealth between English speaking Caribbean nations who take identical exams at the secondary school level, I test the hypothesis that booms alter the incentive for academic excellence in secondary school students. To isolate the impact changing incentives have on academic performance, I control for education expenditure and other demand and supply side factors. Results suggest that booms improve performance mainly for female students. Resource booms are not significantly associated with an increase in the dropout rate, which suggests that the improvement in performance is not the result of an alteration in the composition of students. Results also suggest that the performance of female students are more affected by widespread economic changes whereas the performance of males depends more on family level factors.

Background

British colonies in the Caribbean obtained their independence from the late 1960s to the early 1980s. In 1965, independent states formed the Caribbean Free Trade Association (CARIFTA), which was meant to remove trade barriers and promote the development of the newly independent nations. CARIFTA was superseded by the Caribbean Community (CARICOM) in 1973 and targeted further economic and institutional integration among Caribbean nations. CARICOM includes 5 associate members, all of which are British Overseas Territories and 15 full member states, 12 of which are former British colonies, 1 British Overseas Territory, 1 former French colony and 1 former Dutch colony[22]. Apart from Belize in Central

[22] Associate members: Anguilla, Bermuda, British Virgin Islands, Cayman Islands and Turks and Caicos Islands. Full members: Antigua and Barbuda, the Bahamas, Barbados, Belize, Dominica, Grenada, Guyana, Haiti (former

America, Haiti which shares an island with the Dominican Republic and Guyana and Suriname in South America, all the other CARICOM members are islands. In 2001, the treaty that established CARICOM was revised to clear the way for a single market and economy like the eurozone. However, this level of integration is yet to be achieved as travel between countries is not completely seamless and the larger nations still utilize their own national currencies[23].

One of the institutions that came out of the integration movement in the region is the Caribbean Examinations Council (CXC) which was established in 1972 and recognized as a key CARICOM institution at its formation in 1973. CXC was largely formed to provide examinations and certification to replace the General Certificate of Education (GCE) which was (and still is in some cases) administered in Britain and its former colonies. One of the key examinations that CXC prepares and grades is the Caribbean Secondary Education Certificate (CSEC) examination which is written in May and June of each year with a resit available in January. Secondary school students from 16 English speaking Caribbean territories (5 British Overseas Territories and 11 independent former British colonies) take CSEC exams every year in a range of subjects including Mathematics and English which are compulsory. In 2021, 72,535 students took the mathematics exam[24]. Students are awarded grades ranging from a grade one to a grade six with ones representing the highest grade and sixes representing the lowest grade. A student is considered to have passed an exam if he or she obtains at least a grade three.

French colony), Jamaica, Montserrat (British Overseas Territory), St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Suriname (former Dutch colony) and Trinidad and Tobago.

[23] Several of the smaller island nations (6 independent nations and 2 British territories) have a currency union and use the same Eastern Caribbean (EC) dollar.

[24] The mathematics exam consists of two papers written on separate days. Paper 1 is a multiple-choice exam while Paper 2 is a written exam.

Most secondary school students in CARICOM countries attend public schools. Data from the World Development Indicators shows that for the four largest English-speaking members, Barbados, Guyana, Jamaica and Trinidad and Tobago, private school attendance is relatively uncommon. Based on the most recent available data for the four countries, the percentage of secondary school students enrolled in private schools ranged from 2.29% in 2022 in Jamaica to 12.39% in the same year in Trinidad and Tobago[25].

The population of English-speaking CARICOM members ranges from around 5,000 in Montserrat to just under 3 million in Jamaica. The economies of many of the island territories are tourism based with few natural resources. A few notable exceptions include Trinidad and Tobago which has significant amounts of fossil fuels, Jamaica which has bauxite and Montserrat which was endowed with significant sand deposits following the volcanic eruption that started in 1995. Barbados too has small amounts of fossil fuels but is mainly tourism reliant. Guyana on the South American mainland has significant amounts of bauxite, gold and recently discovered substantial amounts of fossil fuel deposits. Unlike Barbados and Trinidad and Tobago which have been producing oil since the early days of independence, Guyana only began producing oil in earnest in 2019. Since then, Guyana’s economy has experienced significant growth. In 2023, Guyana’s real GDP grew by a whopping 62%.

The standardization of exams at the secondary school level and the variation in resource endowments across the English-speaking CARICOM region provides something of a natural experiment to test the effects of resource booms on educational outcomes. Given the shared history, these countries are similar in institutions, culture, language and many other areas.

[25] The 2022 rate in Barbados was 6.67% while it was 7.93% in Guyana in 2012. Over the last two decades, private secondary school enrolment rates have general increased in all countries except Jamaica.

Consequently, assuming that unobserved factors are fairly common across the region, it is relatively straightforward to identify the effects of resource booms on educational outcomes.

Methodology

The key dependent variable under study is secondary school performance which will be proxied by the percentage of students receiving a passing grade in the May/June CSEC Mathematics examination. The CSEC Math pass rate will be examined separately for male and female students in order to compare effects. The main explanatory variable is an indicator variable that seeks to capture resource booms. The variable takes one if the per capita increase in the contribution to GDP of the mining and quarrying sector is equal to or greater than 15%[26]. The indicator is preferred to a continuous variable like the change in the per capita contribution of the mining and quarrying sector since such a variable would include bust periods and treat booms and bust as opposite sides of the same coin from the perspective of secondary school students. Based on my framework, I am only interested in the effects of booms on student performance. For small countries, short-term variations in the mining and quarrying sector are largely exogenous as they often closely follow international prices beyond their control.

I control for fixed differences between countries with country fixed effects. I also control for population size since the larger Caribbean countries tend to have larger resource endowments. Population size may also increase competition among students, contributing to improved performance. Remittances inflows and visitor arrivals are also included as controls as they are important to the economies of several countries. I also control for average income levels with real per capita GDP and general economic performance with the growth rate of real per

[26] Other cutoff values are used as robustness checks.

capita GDP. Finally, since the main goal is to isolate the potential effect of resource booms on student incentives apart from direct recurrent spending on education, the current per capita expenditure on education is included as a control. The baseline empirical strategy is provided in equation (3.1).

$$Y_{ct} = \alpha + \beta R_{ct} + \gamma X_{ct} + \delta_c + \mu_t + \varepsilon_{ct} \tag{3.1}$$

In this specification the c, and t subscripts index countries and years respectively. Y_{ct} represents the percentage of male/female students who write and pass the mathematics exam. R_c is the resource boom indicator variable that takes one if the per capita change in the contribution of the mining and quarrying sector to GDP in country c exceeds 15%. X_{ct} is a vector of controls that include real per capita GDP, population size, per capita education expenditure, arrivals and real GDP per capita growth. Country and year dummies are included to capture time invariant differences between territories and time specific shocks that similarly affect each country. Consequently, β captures the effect on exam performance of resource booms experienced by a particular country given its average income, educational expenditure, population, tourist arrivals, economic growth, time invariant characteristics and global shocks.

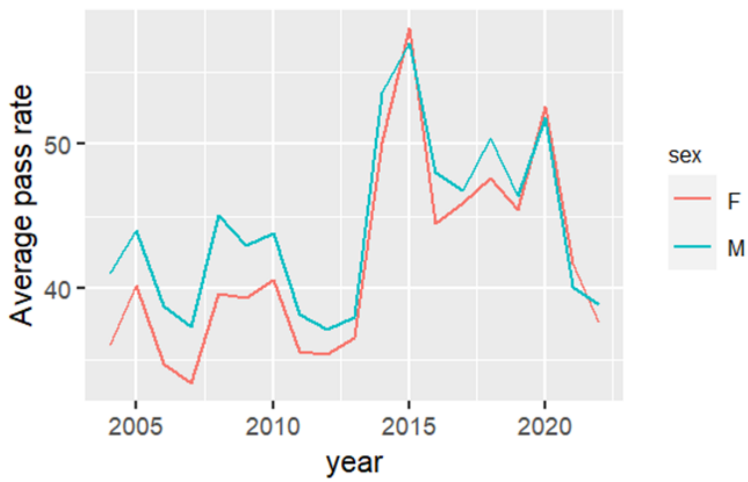
Data

The number of male/female students registered, graded and passing the CSEC mathematics[27] exam in the May/June period from 2004 to 2023 was obtained for Barbados, Guyana, Jamaica and Trinidad and Tobago from CXC. These four countries are the largest English-speaking members of CARICOM and represent around 30% of the group's 19 million total population. Each year the average number of students taking the exam ranges from 3,486 in

[27] Although data was also collected for English scores, focus is placed on mathematics as students perform significantly better in English as compared to math. See Figure A.4 in the Appendix.

Barbados to 36,808 in Jamaica. Figure 3.1 shows the average pass rate for male and female students across the four countries from 2004 to 2022[28]. While male and female performance are highly correlated over the period, male students seem to generally outperform female students on average.

Figure 3.1: Average CSEC Math Pass Rate



Data on the per capita contribution to GDP by the mining and quarrying sector is taken from the World Bank's World Development Indicators (WDI). This data constitutes the key natural resource variable in the analysis and represents different resources for different countries. For many years, the main resource extracted in Guyana was gold followed by bauxite. For example, according to data from the Guyana Bureau of Statistics, in 2010, gold and bauxite accounted for 75% and 16% respectively of mining and quarrying's contribution to GDP. In more recent years, massive petroleum discoveries have led to a drastic shift in composition.

[28] While I have country level data on student performance, this data is considered to be the property of each respective country and as such I am unable to present the data in any form that would link performance to any specific country.

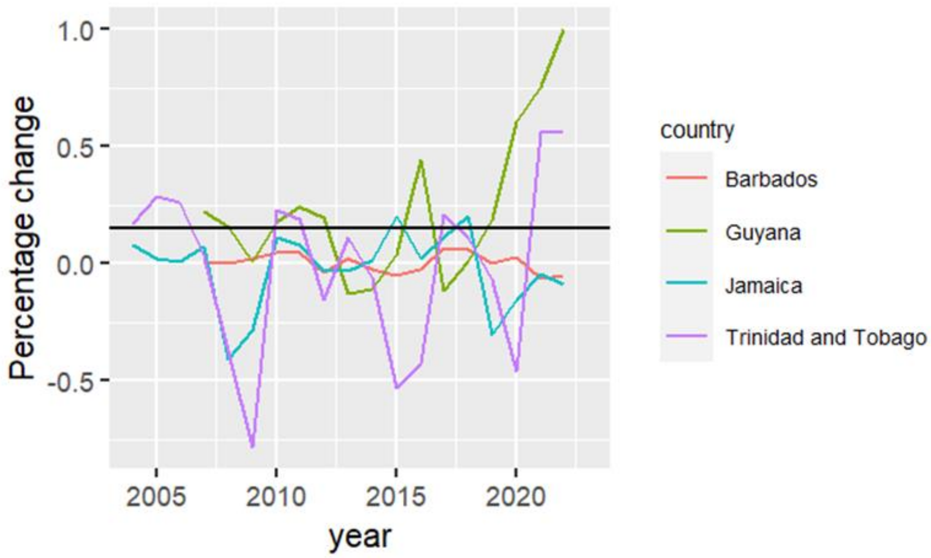
Petroleum extraction increased significantly and constantly from around 2017. In 2022, oil and gas extraction accounted for 92% of mining and quarrying. Like Guyana in recent years, the main natural resources extracted in Trinidad and Tobago and Barbados over the period were oil and gas. However, petroleum extraction is significantly more important to the economy of Trinidad and Tobago than it is to Barbados. Jamaica's main natural resource is bauxite although, like Barbados, natural resources are less important to its economy than Guyana or Trinidad and Tobago. The economies of Barbados and Jamaica are more tourism reliant than natural resource reliant. Table 3.1 presents summary statistics for all the independent variables used in the analysis including mining and quarrying as a share of GDP and tourist arrivals. Data for all the variables in the table are for the period 2004-2022 and come from the WDI.

Table 3.1: Summary Statistics

Variables		Barbados	Guyana	Jamaica	T&T
Mining & quarrying GDP share (%)	Mean	0.22	16.03	1.96	19
	Std Dev	0.04	14.54	1.03	6.78
Mining & quarrying per capita ($)	Mean	38.03	1,457.77	95.2	3,027.73
	Std Dev	7.41	2,674.48	44.34	1,101.96
Remittances per capita ($)	Mean	437.55	439.71	854.42	96.05
	Std Dev	148.46	131.81	191.20	24.95
Per capita education expenditure ($)	Mean	814.14	156.94	263.16	534.14
	Std Dev	143.9	46.82	51.46	120.61
Arrivals	Mean	1,166,500	178,024	3,195,159	477,125
	Std Dev	103,497.5	64,695.71	756,057.2	93,090
Population	Mean	276,123.4	765,643.4	2,761,565	1,447,385
	Std Dev	4,115.16	21,528.38	54,573	57,060
Real GDP per capita ($)	Mean	17,116	6,304	5,157	16,124
	Std Dev	970.8	3,243	165	1613
Real GDP per capita growth (%)	Mean	0	8	0.04	0.5
	Std Dev	4.74	13.00	3.36	5.57

Results[29]

Figure 3.2: Mining and quarrying per capita growth



Note: The horizontal line designates the 15% cutoff that is used to code the indicator resource boom variable.

Before displaying the results, Figure 3.2 reveals how the resource boom variable is coded. It shows the change in the log of the mining and quarrying sector's per capita contribution to GDP for each country over the sample period. The horizontal line represents the designated cutoff which is initially set at 0.15. The resource boom indicator takes one whenever the change in quarrying and mining's per capita contribution to GDP meets or exceeds the cutoff. When the cutoff is set at 0.15, Barbados never experiences a resource boom over the period. Consequently, its inclusion in the analysis serves only as a control. Jamaica only experiences two booms over the entire period. Most of the booms are experienced by Guyana and Trinidad and Tobago, the countries where natural resources play a relatively prominent role in the local economy.

[29] All results should be interpreted with caution given the relatively small/short panel.

Table 3.2: Effects of Resource Booms on the CSEC Math Pass Rate

Dependent Variable	Log of the percentage of graded CSEC students passing Math					
	Male			Female		
Variables	(1)	(2)	(3)	(4)	(5)	(6)
Resource boom indicator	0.0131**	0.00690	0.00352	0.0165***	0.0104***	0.0111**
	(0.00258)	(0.00323)	(0.00458)	(0.00172)	(0.00145)	(0.00277)
Per capita education expenditure		0.0665***	0.0801***		0.0641**	0.0790***
		(0.00780)	(0.00701)		(0.0132)	(0.0109)
Real per capita GDP		-0.0724**	-0.096***		-0.0529	-0.0494*
		(0.0211)	(0.0112)		(0.0275)	(0.0159)
Remittances per capita		0.0399***	0.0415**		0.0360*	0.0359
		(0.00414)	(0.00792)		(0.0142)	(0.0157)
Visitor arrivals		0.0772**	0.0719***		0.0896***	0.0804***
		(0.0183)	(0.00949)		(0.0103)	(0.0121)
Population			-0.201			-0.249**
			(0.175)			(0.0698)
Real GDP per capita growth			0.0636			-0.0155
			(0.0535)			(0.0390)
Observations	70	61	61	70	61	61
R-squared	0.868	0.955	0.957	0.906	0.972	0.973
Adjusted R-squared	0.806	0.926	0.925	0.862	0.953	0.952

Note: Standard errors clustered by country are given in parentheses. The analysis is based on the period 2004-2023 although there are several missing observations for the control variables, particularly in later years. All variables besides the boom indicator are in natural logs and all regressions include year and country fixed effects. The boom indicator takes one if the per capita change in mining and quarrying's contribution to GDP is 15% or greater.

Table 3.2 shows results for equation (3.1). The results suggest that resource booms are associated with around a 1% improvement in the CSEC mathematics pass rate for both male and female students. The estimates are slightly larger and more robust for female students suggesting that booms have a greater positive impact on the performance of female students as compared to male students. Assuming no change in the dropout rate, the fact that the resource boom indicator remains positive and statistically significant after the introduction of control variables like per capita education expenditure suggest that booms increase educational incentives for students which leads to improvements in performance. Perhaps booms improve future employment prospects for individuals with a secondary school diploma thereby increasing the incentive for students to perform well. Another interesting aspect of the results is that they suggest that widespread economic improvements as captured by the resource boom indicator and visitor arrivals, which is a good indicator of the performance of the tourism sector, have a greater impact on the performance of female students as compared to male students. On the other hand, family levels of disposable income as proxied by per capita values of GDP and remittances, have a greater impact on the performance of male students. This seems to indicate that families in the Caribbean prioritize the education of male children over their female counterparts.

Robustness Checks

Thus far I have interpreted the results as suggesting an association between resource booms and improvements in secondary school performance for mainly female students. However, other explanations are possible. For example, resource booms may create increased employment opportunities for teenagers who may then decide to leave school prematurely (Cascio & Narayan, 2022). If weaker students take up jobs, then this would also be consistent with our results as the remaining stronger students are likely to perform better than those who left.

To test whether the results are because of increases in dropouts, I estimate equation (3.1) with registered students as a proportion of the male/female population between the ages of 15 and 19 as the dependent variable. Results shown in Table 3.3 cast doubt on the possibility that the improvements in the math pass rate during resource booms are the result of weak students choosing work over school. However, students must typically register for the exam several months in advance. Therefore, it is likely that students register for the exam but choose to work and not take the exam in the event of a resource boom. To examine this possibility, I calculate the dropout rate as the proportion of students who register for the exam but do not obtain a grade[30]. I again estimate equation (3.1) with this dropout rate as the dependent variable. The results are largely similar as the resource boom indicator in most specifications is not statistically significant[31].

Table 3.3: Effect of Resource Booms on CSEC Math Registration Rates

Dependent Variable	Log of CSEC Math Registration Rate					
	Male			Female		
Variables	(1)	(2)	(3)	(4)	(5)	(6)
Resource boom indicator	0.00419 (0.00355)	0.00276 (0.00259)	0.00403 (0.00363)	0.00240 (0.00835)	-0.000242 (0.00687)	0.00316 (0.00682)
Per capita education expenditure		0.00224 (0.0162)	-0.0107 (0.0226)		-0.00184 (0.0176)	-0.00038 (0.0296)
Real per capita GDP		0.0103 (0.00442)	0.0198 (0.0113)		0.0227* (0.00831)	0.0454* (0.0167)
Remittances per capita		0.00289 (0.00691)	0.00221 (0.00660)		-0.00388 (0.0146)	-0.00529 (0.0154)
Visitor arrivals		0.0158** (0.00485)	0.0223 (0.0102)		0.0594*** (0.00900)	0.0558** (0.0124)
Population			0.204 (0.217)			-0.0471 (0.348)
Real GDP per capita growth			-0.0228 (0.0275)			-0.0660 (0.0383)
Observations	70	61	61	70	61	61
R-squared	0.966	0.975	0.977	0.871	0.934	0.939
Adjusted R-squared	0.950	0.958	0.960	0.811	0.890	0.892

Note: The dependent variable is calculated as the number of registered students divided by the population 15-19 years. Standard errors clustered by country are given in parentheses. The analysis is based on the period 2004-2022 although there are several missing observations for the control variables, particularly in later years. All variables besides the boom indicator are in natural logs and all regressions include year and country fixed effects.

[30] Students are not assigned a grade when they are absent or when sheets are missing from their exam submissions.

[31] The resource boom indicator is negative and significant when the female dropout rate is regressed on the resource boom indicator with country and time fixed effects but without any other controls. Once controls are added the resource boom indicator loses significance.

Finally, the cutoff for the resource boom indicator is changed from 0.15 to 0.2. This change results in a reduction in the number of boom episodes for Guyana and Trinidad and Tobago. The number of booms over the sample period falls from 10 to 6 for Guyana and from 9 to 7 for Trinidad and Tobago. The number of boom episodes for Jamaica is unchanged at 2. Given these changes, the indicator is no longer significant for the male pass rate and maintains significance for the female pass rate only when no controls are included. These results are shown in Table 3.4. This underscores that prior results must be interpreted cautiously given the small sample size.

Table 3.4: Effect of Resource Booms on CSEC Math Registration Rates (20% cutoff)

Dependent Variable	Log of the percentage of graded CSEC students passing Math					
	Male			Female		
Variables	(1)	(2)	(3)	(4)	(5)	(6)
Resource boom indicator	0.00814 (0.00521)	0.00660 (0.00614)	0.00237 (0.00582)	0.00948** (0.00275)	0.00661 (0.00361)	0.00548 (0.00317)
Per capita education expenditure		0.0623*** (0.00837)	0.0778*** (0.00671)		0.0587** (0.0142)	0.0728** (0.0136)
Real per capita GDP		-0.0754** (0.0228)	-0.099*** (0.00923)		-0.0577 (0.0308)	-0.0618* (0.0228)
Remittances per capita		0.0445** (0.00781)	0.0435** (0.00856)		0.0415 (0.0186)	0.0415 (0.0186)
Visitor arrivals		0.0804** (0.0183)	0.0740*** (0.0100)		0.0949*** (0.0117)	0.0862*** (0.0110)
Population			-0.190 (0.155)			-0.235** (0.0549)
Real GDP per capita growth			0.0683 (0.0453)			0.00751 (0.0288)
Observations	70	61	61	70	61	61
R-squared	0.864	0.955	0.957	0.901	0.970	0.971
Adjusted R-squared	0.801	0.925	0.925	0.855	0.950	0.947

Note: Standard errors clustered by country are given in parentheses. The analysis is based on the period 2004-2023 although there are several missing observations for the control variables, particularly in later years. All variables besides the boom indicator are in natural logs and all regressions include year and country fixed effects.

Conclusion

Resource booms seem to have a positive impact on the performance of secondary school students in the Caribbean. This result is slightly stronger and more robust for female as opposed to male students. This may indicate that resource booms improve future job prospects, particularly for female students, thereby creating an incentive for them to improve their performance. However, more research is needed to verify/solidify this idea. The performance of female students seems to be more influenced by widespread economic changes as compared to male performance which is more affected by family level disposable income. This may be indicative of Caribbean families prioritizing the education of male children over females. Current per capita education expenditure is consistently associated with improved performance. Consequently, there seems to be decent evidence that increasing expenditure on things like the wages and salaries of teachers would lead to improvements in the performance of both male and female secondary school students in the Caribbean. However, results should be cautiously interpreted as the sample size is small.

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APPENDIX

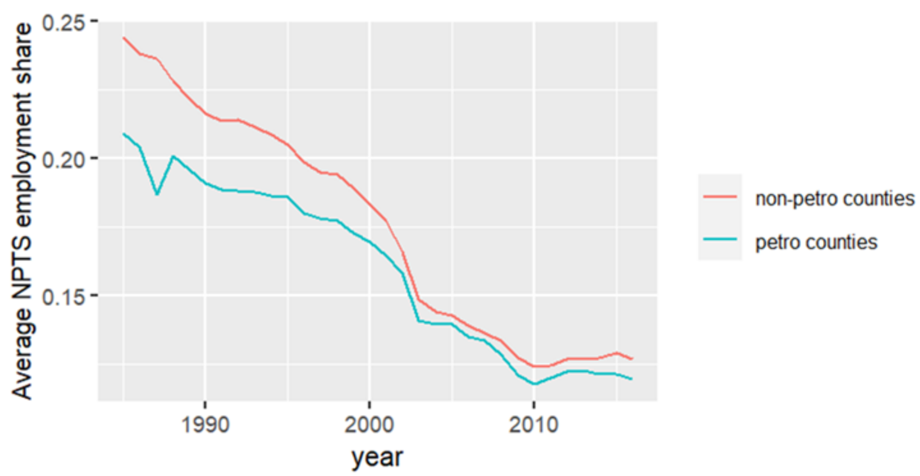
Table A.1: GMM-system estimation of the effects of US influence on export concentration (Within Theil)

Dependent Variable:	Log of the Within Theil Index					
Variables	(1)	(2)	(3)	(4)	(5)	(6)
Lagged total Theil index	0.507*** (0.099)	0.511*** (0.098)	0.488*** (0.121)	0.571*** (0.108)	0.580*** (0.108)	0.536*** (0.135)
US influence	-0.004 (0.014)	-0.008 (0.014)	-0.000 (0.015)	-0.004 (0.012)	-0.007 (0.013)	-0.001 (0.015)
Per capita income	-0.084*** (0.018)	-0.077*** (0.017)	-0.057*** (0.020)	-0.076*** (0.029)	-0.069** (0.033)	-0.049 (0.053)
Population	-0.027*** (0.007)	-0.025*** (0.007)	-0.029*** (0.009)	-0.023*** (0.007)	-0.022*** (0.007)	-0.026** (0.011)
Russian influence	-0.066** (0.027)	-0.070** (0.028)	-0.046* (0.027)	-0.058** (0.026)	-0.060** (0.025)	-0.042 (0.032)
Petro value per person	0.020*** (0.005)	0.019*** (0.004)	0.017*** (0.005)	0.018*** (0.006)	0.017** (0.007)	0.015* (0.008)
Democracy indicator		-0.018 (0.014)	0.001 (0.013)		-0.014 (0.025)	-0.000 (0.017)
Trade openness			-0.068 (0.072)			-0.063 (0.065)
Human capital index			-0.119** (0.053)			-0.113 (0.087)
Observations	2,983	2,983	2,602	2,983	2,983	2,602
Number of countries	116	116	102	116	116	102
AB AR(1)	2.17e-09	1.63e-09	3.22e-07	8.50e-09	6.17e-09	4.87e-07
Hansen	0.236	0.230	0.310	0.0436	0.0440	0.167

Note: Results from one step GMM-system are presented. Robust errors are given in parentheses. All specifications include country and year fixed effects. P-values for the Arellano-Bond AR(1) for serially correlated errors along with the Hansen test of over-identifying restrictions are reported. In columns 1-3, only the lagged dependent variable is considered endogenous and instrumented by lagged values of itself while in columns 4-6, the lagged dependent variable and income per capita are both considered endogenous and instrumented by lagged values of themselves. Besides the indicators, all variables are in logs.

Figure A.1: County averages of NPTS employment for nonpetroleum and petroleum abundant counties

Figure A.2: NPTS employment share



Source: Author generated using CBP employment data and tradable sector classifications from Barkai and Karger (2020)

Figure A.3: Change in the log of US petroleum employment

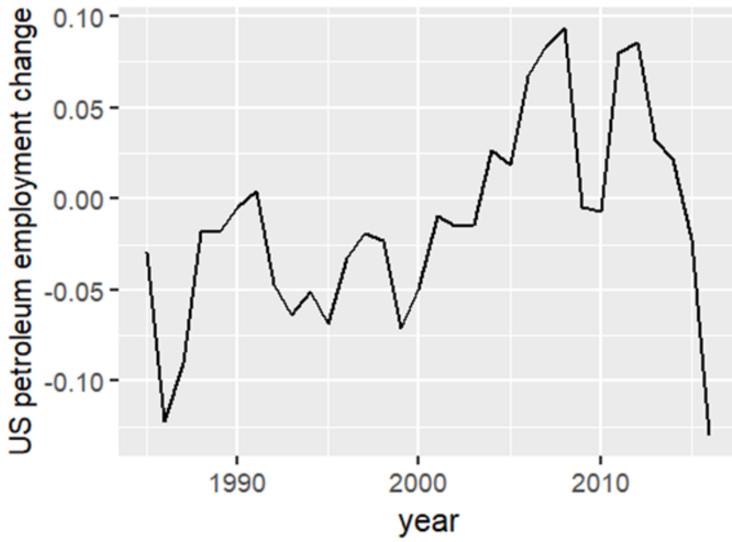


Table A.2: The Effect of Union Membership on the Effect of Petroleum Sector Booms on the NPTS in Petroleum Abundant Counties in the US

Dependent Variables:	Change in the Log of Nonpetroleum Tradable Sector Employment		Change in Log of Share of Nonpetroleum Tradable Sector Employment	
Variables	(1)	(2)	(3)	(4)
Panel A				
% of employed workers who are union members	0.0261 (0.0922)	0.0114 (0.233)	0.0379 (0.0872)	0.0217 (0.229)
Change in national petroleum employment * % of employed workers who are union members	0.809 (1.880)	0.214 (1.923)	1.376 (1.853)	0.841 (1.879)
Observations	24,310	24,310	24,310	24,310
Prob > F	0.911	0.994	0.754	0.903
Adjusted R-squared	0.0704	0.0467	0.0710	0.0462
R-squared	0.535	0.540	0.536	0.539
Panel B				
% of employed workers who are union members	0.244 (0.463)	0.427 (1.136)	0.281 (0.436)	0.370 (1.046)
Change in national petroleum employment * % of employed workers who are union members	4.764 (9.354)	5.011 (10.37)	6.928 (9.103)	7.056 (10.04)
Observations	1,710	1,710	1,710	1,710
Prob > F	0.871	0.818	0.664	0.482
Adjusted R-squared	0.285	0.256	0.287	0.260
R-squared	0.643	0.647	0.644	0.649
Pair-Year Fixed Effects	Yes	Yes	Yes	Yes
County Fixed Effects	No	Yes	No	Yes

Note: Standard errors clustered by state are given in parentheses. The analysis is based on the period 1985-2016 for petroleum abundant county pairs that share a state border. In panel A, the sample is limited to counties that lie above an oil or gas field, while in panel B it is limited to counties that lie above a top 100 oil or gas field in 2013.

Table A.3: The Effect of Union Membership on the Effect of Petroleum Sector Booms on the NPTS in Petroleum Abundant Counties in the US (1998-2016)

Dependent Variables:	Change in the Log of Nonpetroleum Tradable Sector Employment		Change in Log of Share of Nonpetroleum Tradable Sector Employment	
Variables	(1)	(2)	(3)	(4)
Panel A				
% of employed workers who are union members	0.0730	0.0256	0.0772	0.0193
	(0.126)	(0.299)	(0.127)	(0.310)
Change in national petroleum employment * % of employed workers who are union members	0.227	-0.334	1.361	0.750
	(2.905)	(3.047)	(2.749)	(2.850)
Observations	13,848	13,846	13,848	13,846
Prob > F	0.845	0.992	0.754	0.960
Adjusted R-squared	0.0109	-0.00994	0.00375	-0.0174
R-squared	0.506	0.525	0.502	0.521
Panel B				
% of employed workers who are union members	0.292	0.552	0.332	0.351
	(0.419)	(1.435)	(0.390)	(1.330)
Change in national petroleum employment * % of employed workers who are union members	2.276	2.944	5.908	6.696
	(13.19)	(14.84)	(12.78)	(14.10)
Observations	1,016	1,016	1,016	1,016
Prob > F	0.449	0.891	0.624	0.874
Adjusted R-squared	0.113	0.0591	0.0828	0.0309
R-squared	0.558	0.570	0.543	0.557
Pair-Year Fixed Effects	Yes	Yes	Yes	Yes
County Fixed Effects	No	Yes	No	Yes

Note: Standard errors clustered by state are given in parentheses. The analysis is based on the period 1998-2016 for petroleum abundant county pairs that share a state border. In panel A, the sample is limited to counties that lie above an oil or gas field, while in panel B it is limited to counties that lie above a top 100 oil or gas field in 2013.

Table A.4: The Effect of Union Impact on the Effect of Petroleum Sector Booms on the NPTS in Petroleum Abundant Counties in the US (1998-2016)

Dependent Variables:	Change in the Log of Nonpetroleum Tradable Sector Employment		Change in Log of Nonpetroleum Tradable Sector Employment Share	
Variables	(1)	(2)	(3)	(4)
Panel A				
% of workers covered by a collective bargaining agreement by state	0.102	0.0532	0.104	0.0247
	(0.123)	(0.274)	(0.126)	(0.282)
Change in national petroleum employment * % of workers covered by a collective bargaining agreement	0.455	0.171	1.453	1.069
	(2.517)	(2.650)	(2.361)	(2.465)
Observations	13,848	13,846	13,848	13,846
Prob > F	0.709	0.972	0.619	0.885
Adjusted R-squared	0.0110	-0.00993	0.00386	-0.0174
R-squared	0.506	0.525	0.502	0.521
Panel B				
% of workers covered by a collective bargaining agreement by state	0.203	0.0944	0.215	-0.190
	(0.280)	(0.881)	(0.256)	(0.832)
Change in national petroleum employment * % of workers covered by a collective bargaining agreement	2.024	2.048	4.513	4.584
	(10.81)	(11.51)	(10.30)	(10.64)
Observations	1,016	1,016	1,016	1,016
Prob > F	0.580	0.984	0.688	0.789
Adjusted R-squared	0.113	0.0583	0.0819	0.0301
R-squared	0.558	0.570	0.542	0.557
Pair-Year Fixed Effects	Yes	Yes	Yes	Yes
County Fixed Effects	No	Yes	No	Yes

Note: Standard errors clustered by state are given in parentheses. The analysis is based on the period 1998-2016 for petroleum abundant county pairs that share a state border. In panel A, the sample is limited to counties that lie above an oil or gas field, while in panel B it is limited to counties that lie above a top 100 oil or gas field in 2013.

Table A.5: The Effect of Right to Work Laws on the Impact of Petroleum Sector Booms on the NPTS in Petroleum Abundant Counties in the US (1998-2016)

Dependent Variables:	Change in the Log of Nonpetroleum Tradable Sector Employment		Change in Log of Nonpetroleum Tradable Sector Employment Share	
Variables	(1)	(2)	(3)	(4)
Panel A				
RTW county indicator	0.00711	-0.0442	0.00729	-0.0412
	(0.0102)	(0.0267)	(0.00922)	(0.0272)
Change in national petroleum employment * RTW County Indicator	0.0395	0.0571	-0.0599	-0.0320
	(0.316)	(0.328)	(0.319)	(0.323)
Observations	8,874	8,872	8,874	8,872
Prob > F	0.604	0.271	0.660	0.331
Adjusted R-squared	0.0155	-0.00792	0.00452	-0.0177
R-squared	0.508	0.527	0.502	0.522
Panel B				
RTW county indicator	0.00404	0.00273	0.00217	0.0415
	(0.00573)	(0.0963)	(0.00535)	(0.0971)
Change in national petroleum employment * RTW County Indicator	-0.174	-0.180	-0.393**	-0.349
	(0.328)	(0.359)	(0.171)	(0.195)
Observations	902	902	902	902
Prob > F	0.775	0.882	0.109	0.201
Adjusted R-squared	0.115	0.0598	0.0824	0.0297
R-squared	0.559	0.571	0.543	0.557
County Pair-Year Fixed Effects	Yes	Yes	Yes	Yes
County Fixed Effects	No	Yes	No	Yes

Note: Standard errors clustered by state are given in parentheses. The analysis is based on the period 1998-2016 for petroleum abundant county pairs that share a state border where RTW status differs at some point over the period. In panel A, the sample is limited to counties that lie above an oil or gas field, while in panel B it is limited to counties that lie above a top 100 oil or gas field in 2013.

Figure A.4: Average CSEC Math and English pass rates

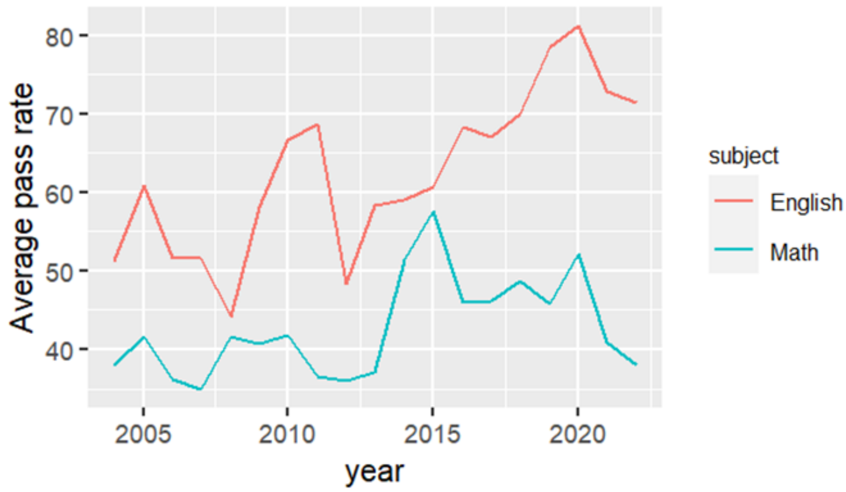
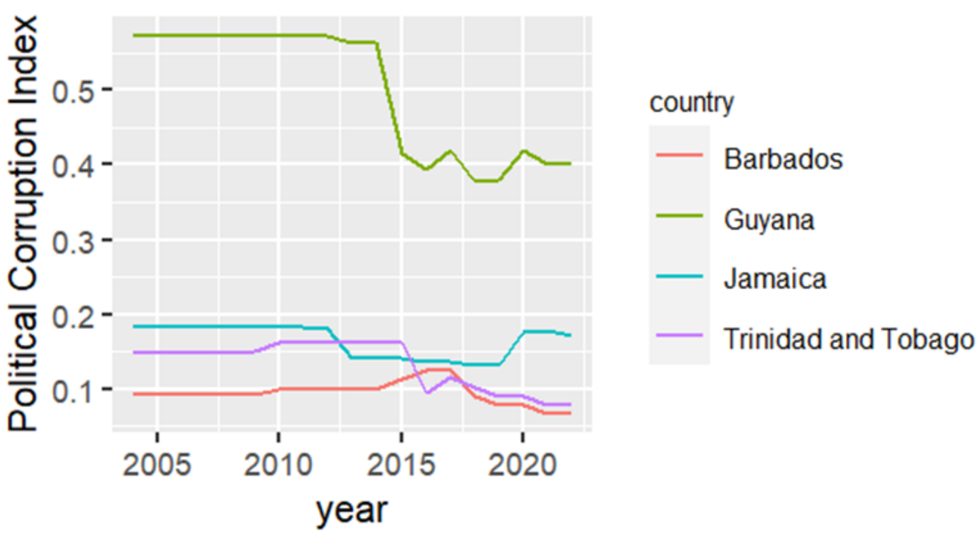


Figure A.5: Political Corruption Index for CARICOM countries



Note: A higher index value represents more corruption

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Major Professor: Kevin Sylwester