Department of Economics Discussion Paper Series

Oil Discoveries and Protectionism

Fidel Perez-Sebastian, Ohad Raveh, Frederick van der Ploeg

Number 895
December, 2019

Department of Economics
Manor Road Building, Manor Road
Oxford, OX1 3UQ

ISSN 1471-0498

Oil Discoveries and Protectionism[§]

Fidel Perez-Sebastian[*], Ohad Raveh[**], Frederick van der Ploeg[***]

Abstract

Can oil discovery shocks affect the demand for protectionism? A two-period model of Dutch disease indicates that if the tradable sector is politically dominant then an oil discovery induces protectionism. If the economy is also credit constrained, this effect is intensified upon discovery, but partially reversed when oil revenues start to flow. We test these predictions using detailed bilateral tariff data that cover 96 products in 155 countries over the period 1988-2012, and worldwide discoveries of giant oil and gas fields. Our identification strategy rests on the exogeneity of the timing of discoveries. We find that an oil discovery increases tariffs during pre-production years and decreases tariffs in the years to follow yet to a lesser extent, most notably in capital scarce economies with a relatively dominant tradable sector. Our baseline estimates indicate that a giant oil field discovery induces a rise of approximately 15% in the average tariff over the course of 10 years; this increase is about 1.8 times larger during the pre-production period when the oil discovery represents a pure news shock.

Keywords: Oil discoveries, protectionism, capital scarcity, Dutch disease, political economy, trade policy, news shocks

JEL codes: Q32, F13, O24

Revised December 2019

[§] We are grateful for helpful comments received at the EARE Conference, Manchester, 2019, the 5th International Workshop on Economic Growth, Environment and Natural Resources, European University Workshop, Saint Petersburg, 2019, and the Mundlak Workshop, Hebrew University, 2019, and at seminars at UPO, Seville and the University of Economics, Prague.

[*] Department of Economics, University of Alicante and University of Hull. Email: fidel.perez@ua.es.

[**] Department of Environmental Economics and Management, Hebrew University of Jerusalem. Email: ohad.raveh@mail.huji.ac.il.

[***] Department of Economics, University of Oxford. Email: rick.vanderploeg@economics.ox.ac.uk. Also affiliated with VU University Amsterdam, CEPR and CESifo.

1. Introduction

Understanding the determinants of protectionism has been a long-standing interest of economists and policy makers.[1] Recent developments in the political context of many countries call for a reduction in the level of globalisation. The desire to raise protectionism in periods of negative or slow growth is not new, but since the last global financial crises it has even manifested itself in economies that historically have strongly endorsed free trade.[2] While the literature considered a range of determinants for these patterns, the potential role of oil discoveries has received relatively little attention. This is surprising because the anticipation and wealth effects induced by major oil discoveries have significant impacts on the tradable sectors of small open economies.[3] We aim to fill this gap by exploring the role of oil discoveries in inducing protectionism. We provide theoretical foundations and empirical evidence for the impact of oil discoveries on the level of tariffs, illustrating that such discoveries can lead to higher levels of protectionism in a robust and economically meaningful magnitude that depends on the extent of financial constraints, dominance of the tradable sector, and whether the policy decision is made before or after the discovery entered its production phase.

The latter point provides further motivation for our work. Following the seminal ideas in Pigou (1927) and Keynes (1936), the literature has explored how expectations and news shocks about possible future events are important in the decisions made by forward-looking agents and how they affect macroeconomic outcomes.[4] Although attention has focused on quantification of the effects of news shocks on the consumption and investment decisions made by private agents and their effect on macroeconomic outcomes, less attention has been devoted to the impact of news shocks on the design of policy.[5] But because private and public agents' behaviours are not driven by the same goals (see, among others, Pritchett 2000, and Besley and Burgess 2002), the response of the latter to news shocks should be studied separately. We address this shortcoming by focusing on the role of oil discoveries. Doing so enables us to distinguish between the impact before and after production has started. The anticipation effects induced in the former period, as noted by Arezki et al. (2017), can be considered

[1] See, e.g., Costinot et al. (2015), and Gawande and Krishna (2003), and references therein.
[2] One example is the U.S. Specifically, the U.S. President Donald Trump recently claimed that protectionism leads to greater prosperity (Trump, 2017). Indeed, the 2018 wave of tariff increases in the U.S. represent the most comprehensive protectionist trade policies implemented there since 1971 (Fajgelbaum et al., 2019).
[3] Recent studies that support this view include Arezki et al. (2017), and Harding et al. (2019). More generally, the vast literature on the Dutch disease mechanism (Corden and Neary, 1982), which highlights that resource booms induce appreciation of the real exchange rate that contracts the tradable sectors, points at similar directions (see van der Ploeg (2011) for a survey of the related literature).
[4] More specifically, papers have mainly explored quantitatively the contribution of news shocks to observed business cycle fluctuations in environments in which the private sector forms estimates about the future based on different sources of information. This literature includes closed economy models (see Beaudry and Portier, 2014, for a review), open economy setups, like Jaimovich and Rebelo (2009), and time series analyses such as Beaudry and Portier (2006) and Barsky et al. (2014), among others. Other works have focused on their effects of news shocks on the current account immediately after a giant oil discovery and after oil production finally takes place (see, e.g., Arezki et al., 2017, for a review).
[5] Some exceptions include, for example, Lorenzoni (2010) and Gambetti (2017), which explore the effects of news shocks on monetary policy, and Bianchi et al. (2016) that studies their impact on macroprudential policy.

pure news shocks. Exploiting this feature, we find that news shocks associated with oil discoveries have an important role in inducing the temporal pattern of protectionism.

Our analysis focuses on changes in tariffs. As Ludema et al. (2010) and Furceri et al. (2018), among others, argue, tariffs are a good variable for studying trade policy. First, tariffs are the preferred protectionist instrument for many governments and are easy to measure. Second, they are often changed and modified, even in countries that are members of the World Trade Organisation (WTO). This, in turn, gives the necessary variability for identification purposes. In the United States, for example, Congress regularly passes Miscellaneous Tariff Bills, each containing hundreds of changes to the harmonised tariff schedule. Third, tariff changes represent discretionary policies that are much less internationally constrained than other trade policies. The only rule for WTO members is that they do not raise their tariffs above their bound rates.

We start by providing foundations for the effect of oil discoveries on tariff formation. We present a two-period model of Dutch disease in which the government can borrow from the rest of the world and tariffs are endogenously determined. If access to global capital markets is imperfect, a premium on foreign debt must be paid. The government welfare function is, as in Long and Vousden (1991), a weighted sum of the utilities obtained by the three different groups in society. Each of these three groups owns a different input: tradable-sector-specific capital, non-tradable-sector-specific capital, and labour. We study the impact on tariffs of an anticipated oil discovery before and after oil extraction starts under different credit conditions. Before the oil-extraction stage, the oil discovery constitutes a pure news shock. We show that if the government objective function attaches equal utility weights to capital owners in each sector and to wage earners (in which case it maximises aggregate Hicksian consumption) tariffs are not an optimal outcome. However, if the government wants to protect the interests of capital owners in the traded industry against the Dutch disease, it chooses to impose a positive tariff even ahead of the windfall, upon news of the oil discovery, and to smooth consumption and the tariff via judicious debt management over time. In addition, if the economy is credit constrained and debt management is hampered, the government puts up a higher tariff in the announcement period than during the windfall period and partially lower the tariff once oil production starts.

We econometrically test these predictions using detailed bilateral tariff data. The sample covers 96 two-digit-level products in 155 countries over the period 1988-2012. As a measure of the wealth windfall, we employ worldwide discoveries of giant oil and gas fields. Our identification strategy rests on the plausible exogeneity of the timing of discoveries, and the unique feature of these data that enables distinguishing between the periods before production has started and the period once production has started. Using the methodology proposed by Arezki et al. (2017), we find empirically that an oil discovery increases tariffs during pre-production years and decreases tariffs in the years to follow but to a lesser extent, most notably in capital scarce economies with a relatively dominant tradable sector. News about oil discoveries in the country, therefore, appear to increase protectionism. We perform

several robustness exercises and find that these results are remarkably robust. They are also quantitatively large: our baseline estimates indicate that a giant oil field discovery induces an increase of approximately 15% in the average tariff over the course of 10 years, and almost double this amount during the pre-production period.

The paper contributes to several additional strands of literature. First, we develop novel political economy implications of the Dutch disease. Corden and Neary (1982) highlighted the potential negative impact of a discovery of natural resources on the tradable industries due to the appreciation of the real exchange rate. Recent empirical studies indicate that the various aspects of this mechanism gain support in cross-country data (e.g., Arezki et al. (2017), Harding et al. (2019)). While the use of tariffs to ameliorate Dutch disease effects has been noted before, to our best knowledge there has not been any attempt to study its mechanisms, direction and magnitude.[6] The current effort fills this gap, and shows that it is optimal to react to an oil discovery by raising tariffs, especially during the period after the discovery but before oil production has started. Furthermore, in capital-constrained economies tariffs help to compensate the lack of effective debt management to smooth consumption.

Second, we contribute to the literature on the political economy determinants of tariff policy.[7] Since Adam Smith (1776), most orthodox economists support free trade as the preferred scenario. According to this view, many of the observed barriers to international trade are the result of policymakers that do not maximise pure social welfare. One explanation is that protectionism is due to vested interests in the political marketplace, as proposed by Grossman and Helpman (1994), among others. Notably, this literature has largely focused on explaining why protectionism may rise during bad periods, in contrast to in recent times (e.g., Trump (2017)). Our contribution here is twofold. First, we study the role of an additional determinant, namely the news effects of oil discoveries. Second, we provide new insights concerning the desire to raise the extent of protectionism during good periods.

Third, we provide additional evidence on the willingness to raise tariffs in periods of economic expansion. Lake and Linask (2017) find evidence that tariffs are procyclical if they are motivated by terms of trade effects. More specifically, economic expansions lead to a stronger power of importers on product markets, and then, under the terms of trade hypothesis (see, e.g., Nicita et al. (2018) and Ludema and Mayda (2013) for references), to higher optimal tariffs that reduce world demand and prices for the imported goods, thus improving the country's terms of trade. Our analysis is complementary to this terms of trade perspective. We propose a novel mechanism that also helps explain why tariffs can increase when the economy enjoys a windfall in income.

[6] Collier and Venables (2011) consider the illusory nature of tariff revenues in trade policies of resource-rich economies. Our framework differs by accounting for Dutch disease, optimal tariffs, and anticipation effects in an intertemporal context as well as by considering more explicitly the role of political distortions. Due to the presence of a non-traded sector in our model, the real revenue from import tariffs is no longer illusory.

[7] McLaren (2016) provides a review of this literature.

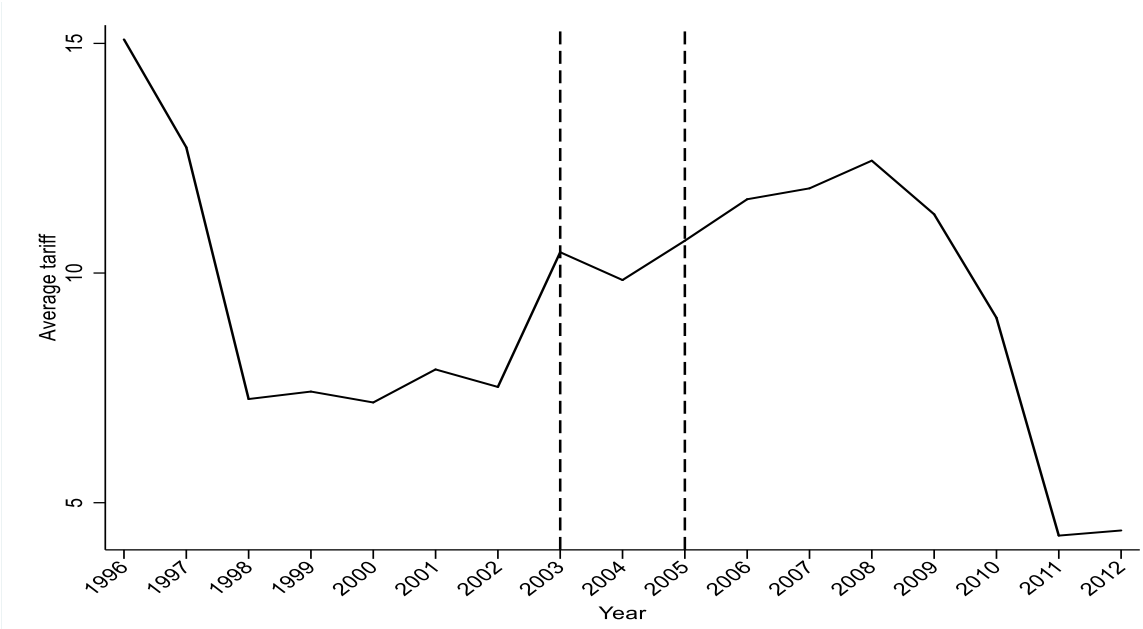
Finally, our paper is also related to the literature on booms, rent seeking and economic growth, although the goal and approach are very different. Papers in this literature, like Tornell and Lane (1999) and Mehlum et al. (2006), among others, argue that income booms can generate rent-seeking behaviour usually rooted in the political process that can hurt economic growth. In our model, the government's behaviour at favouring exporters could also be attributed to rent seeking. However, the rents extracted by these exporters are a consequence of higher prices in domestic markets instead of a direct expropriation of income from the booming sector. Our goal is also different, because we focus on the impact of the shocks on tariff choice instead of on economic growth.

The rest of the paper is organised as follows. Section 2 motivates our analysis with two examples. Section 3 presents and develops predictions from a simple analytical model. Section 4 presents our empirical results and baseline analysis. Section 5 presents various robustness tests. Section 6 concludes.

2. Motivation: Malaysia and Indonesia

The experience of the East Asian economies of Malaysia and Indonesia serve to illustrate the possible link between natural resource windfalls and protectionist measures, and the importance of political economy. Since the 1970s, the Malaysian economy relies heavily on natural resource income. In 2004 about 22 percent of industrial output in the country came from minerals, mostly petroleum and natural gas (WTO, 2004). In 2003-2005, new giant oil and gas fields were discovered in the Malaysian territory, and the economy showed the familiar symptoms of a Dutch disease.

Figure 1: Average tariffs in Malaysia, 1996-2012



Notes: Figure plots the average annual ad-valorem tariffs in Malaysia, 1996-2012. Giant oil fields were discovered in 2003-2005, marked in the period within the dashed lines.

In particular, the real exchange rate appreciated 11 percent from 2005 to 2008, leading to a deterioration of the manufacturing sector's competitiveness. For instance, between 2000 and 2008 the Malaysian trade surplus of machinery and transport equipment went down by 14 percent, while concurrently increasing in other East Asian nations such as China, Singapore, South Korea and Taiwan. As William Leong (2009), a member of the Malaysian Parliament, has argued, the presence of pressure groups (rent seekers that have privatised and created monopolies in some sectors such as water and electricity) have contributed to this bad performance of the economy. Figure 1 shows that these events coincide with an average increase in the level of protectionism in Malaysia around the time of the giant oil and gas fields discoveries, followed by a wave of liberalisation when oil production commenced around 2009. As will be evident in the analysis to follow, these intertemporal patterns are observed under a more general sample of countries when controlling for other explanatory factors and are robust.

A more subtle example is Indonesia, which has gone through various commodity booms accompanied by an increase in protectionist measures.[8] A rapid increase in the price of oil led to the oil booms of 1973–74 and 1979–80. Even though strong Dutch disease effects could not be observed due to repeated currency devaluations, the oil boom still caused reallocation of resources from manufacturing to oil extraction activities. As a consequence, the development of some manufacturing industries, like base metals, petrochemicals, automotive and electronics became a policy priority (Kuncoro, 2018). The goal was to use the income from oil extraction to develop sectors in which state-owned enterprises could play a big role. This brought important import substitution policies that included more tariff and non-tariff barriers (Widodo, 2008). Hill (1997) argues that the pressure that certain groups generated to secure protection is important for understanding these increasing trade barriers.

In 2001, palm oil and coal prices rapidly increased causing a new commodity boom in Indonesia that lasted between 2001 and 2012. This time, the symptoms of a Dutch disease were more evident. According to Nehru (2012), the real exchange rate increased by nearly 24 percent between year 2000 and 2012. This caused a partial reversal of Indonesia's successful process of diversification into manufacturing that took place during the 1990s in sectors like chemicals, cements and machinery, just to name a few (Kuncoro, 2018). The political response was to implement inward-looking policies, protection of domestic markets and industries. For example, Marks (2017) finds that the nominal and the effective rates of protection have increased in Indonesia from 2008 to 2015. Interestingly, Wihardja (2016) argues that these protectionist policies were mainly the results of rent-seeking activities.[9]

[8] Indonesia experienced multiple and consecutive giant oil field discoveries throughout the 1990s, making it difficult to assess their impact descriptively. Nonetheless, it serves as a useful illustration via the observations related to some of its other commodity shocks.

[9] Other papers such as Caselli and Michaels (2013) have emphasised the importance of rent-seeking activities related to oil revenues, but do not analyse trade policy.

3. Political Economy of Tariffs and Anticipated Oil Windfalls

Here we demonstrate that a tariff on imports of tradables can be attractive for governments that want to protect the interests of capital owners in the traded sector relatively more than the interests of workers and other capital owners in face of Dutch disease effects stemming from an oil windfall. In addition, we show that the chosen tariff is implemented upon news of the oil discovery even before oil extraction begins, yet is reversed to some extent once oil production begins and oil revenues start to flow if the country faces capital scarcity and has to pay an interest premium on foreign debt.

3.1. A three-goods model of Dutch disease and tariffs

Consider a small open economy which consumes tradables and non-tradables, both produced at home, and importables which are infinitely elastically supplied at an exogenous world price q.[10] The world price of tradables is normalised to 1 and the price of non-tradables is denoted by p. Imports of tradables face an ad valorem tariff τ, so that domestic consumers face a price $1+\tau$. The three goods are imperfect substitutes in consumption. Consumer demand is homothetic. Rents in the traded and non-traded sectors accrue to a specific fixed factor, say capital, as in the Ricardo-Viner model.[11] The total labour supply is fixed and moves freely between the domestic sectors, but not internationally.

Consumer expenditure is given by: $e(p,\tau,q)c = pc^N + (1+\tau)c^T + qm,$ where c denotes Hicksian consumption, c^N and c^T are consumption of non-tradable and tradable goods, respectively, and $e(.)$ denotes the unit-expenditure function. This last function is homogeneous of degree one. Consumption of non-tradables, tradables and importables can be obtained from Shephard's lemma as $c^N = e_p c, c^T = e_\tau c$ and $m = e_q c,$ respectively. Household utility is $u(c^N, c^T, m) = c.$

Each sector operates under perfect competition and constant returns to scale. Producers of non-tradables choose employment l^N to maximise short-run profits $\pi^N = pf(k^N, l^N) - wl^N,$ where k^N denotes sector-specific capital, w the wage and $f^N(.)$ the concave production function. Labour demand follows from $p\partial f^N / \partial l^N = w.$ Similarly, for the traded sector we get $\pi^T = (1+\tau) f^T(k^T, l^T) - wl^T$ and $(1+\tau)\partial f^T / \partial l^T = w.$ Labour market equilibrium requires $l^N + l^T = 1,$ where exogenous labour supply has without loss of generality been set to unity. Following Neary (1988), we define the GNP function $y(p,\tau).$ This gives the maximum level of GNP with equilibrium on the labour market imposed, i.e. $y = py^N + (1+\tau)y^T,$ where $y^N = y_P$ and $y^T = y_\tau.$ The cross derivatives of the GNP function are negative, since reallocation of labour occurs towards the sector whose price is increased. GNP is distributed as profit and wage income, i.e. $y = \pi^N + \pi^T + w.$

[10] We have foreign-produced importables; else, imports of tradables would just equal oil revenue.
[11] We ignore dynamics of capital stocks and absorption constraints (e.g. van der Ploeg and Venables, 2013).

Current account equilibrium requires $c^T + qm = y^T + n + b,$ and non-traded goods market equilibrium requires $c^N = y^N,$ where y^T denotes production of tradables, *n* windfall revenue, and *b* government borrowing from abroad.[12] This equation implies that the consumption of importables, $qm,$ plus imports of tradables, $\lambda \equiv c^T - y^T,$ is financed by windfall revenue *n* or borrowing *b*.

Employing the consumer expenditure function, the conditions for equilibrium on the current account and market clearing in the non-tradable goods market become

$$e(p,\tau)c = y(p,\tau) + n + b + \tau\left[e_\tau(p,\tau)c - y_\tau(p,\tau)\right], \tag{1}$$

$$e_p(p,\tau)c = y_p(p,\tau), \tag{2}$$

where we assume for simplicity set the price of importables *q* to 1. We can solve (1) and (2) for *p* and *c* in terms of *n, b* and τ, and thus write all variables in terms of *n* and τ; e.g. $\lambda = \lambda(n,b,\tau)$. To gain insight into the comparative statics, we totally differentiate (1) and (2) and obtain

$$edc = (1+\tau\lambda_n)d(n+b) + \tau\lambda_\tau d\tau, \tag{3}$$

$$\frac{dp}{p} = \frac{1}{\varepsilon^S + \varepsilon^N}\left(\frac{1}{ec}\left[(1+\tau\lambda_n)d(n+b) + \tau\lambda_\tau d\tau\right] + (\varepsilon^{NC} + \varepsilon^{SC})\frac{d\tau}{1+\tau}\right), \tag{4}$$

where $\varepsilon^S \equiv py_{pp}/y_p > 0$ and $\varepsilon^N \equiv -pe_{pp}/e_p > 0$ define the own price elasticities, and $\varepsilon^{SC} \equiv -(1+\tau)y_{p\tau}/y_p$ and $\varepsilon^{NC} \equiv (1+\tau)e_{p\tau}/e_p$ the cross-price elasticities for supply of non-tradables and the compensated demand for non-tradables. The supply of non-tradables decreases with the tariff, so that $y_{p\tau} < 0$ and $\varepsilon^{SC} > 0.$ We assume that consumption of non-tradables and tradables are Hicksian substitutes, so that $e_{p\tau} > 0$ and $\varepsilon^{NC} > 0.$

The interpretation of equations (3) and (4) is as follows. Without a tariff, a windfall and borrowing from abroad boosts Hicksian consumption. These also raise the price of non-tradables, and more so if the own price elasticities of supply and compensated demand are large. This relocates labour from the traded to the non-traded sector. Profits in the non-traded sector and wage income rise, but profits in the traded sector decline. Since a windfall boosts import of tradables, $\lambda_n > 0,$ we see from (3) and (4) that the effect of the windfall on Hicksian consumption and the price of non-tradables is larger if there is a pre-existing tariff on tradables. Furthermore, since $\lambda_\tau < 0,$ equation (3) establishes that Hicksian consumption is maximised (for a given level of debt *b*) if the government sets the tariff to zero. The

[12] Private agents do not have access to international capital markets. This should not affect our qualitative results because the consumption smoothing role of debt is already captured through government debt.

reason is that tariffs distort relative prices and depress social welfare defined as the aggregate of consumption across all groups in society.

Around $\tau = 0$, the comparative statics of the model become $\frac{dp}{p} = \frac{1}{\varepsilon^S + \varepsilon^N}\left(\frac{d(n+b)}{ec} + (\varepsilon^{NC} + \varepsilon^{SC})d\tau\right)$ and $dc = d(n+b)/e.$ Introducing a small tariff thus does not affect Hicksian consumption but does make non-traded production relatively more attractive and boost the price of non-tradables. This expands non-tradables output and curbs tradables output. This general equilibrium effect offsets some of the beneficial effect of the tariff on profits in the traded sector and some of the adverse effect on profits in the non-traded sector; in addition, it reinforces the positive effect of the tariff on the wage. The tariff, however, does not affect the real value of the sum of wage income plus profits of capitalists in the two sectors, i.e. Hicksian consumption is unaffected by a small tariff.[13]

3.2. Income distribution and political economy of tariffs

Total government revenue consists of the windfall and tariff revenue plus borrowing, i.e. $s = n + \tau\lambda + b.$ There are three competing groups in society: owners of capital in the traded sector receiving profits π^T, owners of capital in the non-traded sector receiving profits π^N, and workers receiving wage income *w*. Shares β^T and β^N of public revenue are received by owners of capital in the traded and non-traded sectors and a share β^W by workers, where $\beta^T + \beta^N + \beta^W = 1.$ Indirect utilities are $u^T = (\pi^T + \beta^T s)/e,$ $u^N = (\pi^N + \beta^N s)/e$ and $u^W = (y - \pi^N - \pi^T + \beta^W s)/e$ with $u^T + u^N + u^W = c$ as $ec = y + s.$

Following Long and Vousden (1991), the government has the objective function[14]

$$(5) \qquad \omega \equiv \gamma^N u^N + \gamma^T u^T + \gamma^W u^W = \left(\gamma^T(\pi^T + \beta^T s) + \gamma^N(\pi^N + \beta^N s) + \gamma^W(y - \pi^N - \pi^T + \beta^W s)\right)\frac{1}{e},$$

where $s = n + b + \tau\lambda$ and *c* and *p* follow from (3) and (4). The welfare weights γ^N, γ^T and γ^W are normalised so $\gamma^N + \gamma^T + \gamma^W = 1.$ A neutral government sets $\gamma^N = \gamma^T = \gamma^W = 1/3$ so (5) boils down to Hicksian consumption, i.e. $\omega = c = (y + s)/e,$ and the optimal tariff (given the nation's debt *b*) is zero. A political government distorts these welfare weights. If it only cares about utility of traded-sector capitalists ($\gamma^T = 1$ and $\gamma^N = \gamma^W = 0$), it maximises $\omega = (\pi^T + \beta^T s)/e$ taking debt *b* as given so that

[13] In the absence of importables, it can be shown that $e\partial(s/e)/\partial\tau = n(pc^N/ec).$ As the non-traded sector shrinks to zero, the effect of the import tariff on real government revenue, *s/e*, becomes completely illusory, i.e. $\partial(s/e)/\partial\tau \to 0,$ as in Collier and Venables (2011). In general, the rise in the real value of import tariff revenue is not fully offset by a drop in the real value of oil revenue.

[14] This short cut avoids setting up a principal-agent problem as in Grossman and Helpman (1994).

(6) $$\frac{\partial \pi^T}{\partial \tau} + \beta^T \lambda \left(1 - \varepsilon^M \frac{\tau}{1+\tau}\right) = u^T \frac{\partial e}{e \partial \tau} \quad \text{with} \quad \varepsilon^M \equiv -\frac{(1+\tau)\partial \lambda}{\lambda \partial \tau} > 0,$$

Hence, the tariff is set so that the marginal increase in traded-sector profits and tariff revenue (net of erosion of the tariff base) is set to the marginal increase in the cost of living for traded-sector capitalists. In our empirical work we do not distinguish between tradables and non-tradables sectors, but we do show that products that are less imported (at the partner-specific level) receive protection. Our hypotheses on protectionism are validated for all key manufacturing sectors. Further, we show that in open economies the extent of protectionism is stronger.

3.3. Optimal policies in a dynamic setting

The interest that must be paid on foreign debt is $r = (1+\rho)\big(1+\Theta(b)\big) - 1$ for $b > 0$ with $\Theta' > 0$ and $r = \rho$ for $b \leq 0,$ where $\rho > 0$ indicates the pure rate of time preference and $\Theta(b)$ denotes the interest premium (cf. van der Ploeg and Venables, 2011). We denote period-one by small variables and period-two by capitals. Denoting the future tariff by *T*, the two-period model consists of (1), (2),

(7) $$E(P,T)C = Y(P,T) + N - (1+\rho)\big(1+\Theta(b)\big)b + T\big[E_T(P,T)C - Y_T(P,T)\big],$$

(8) $$E_P(P,T)C = Y_P(P,T).$$

These equations can be solved for (c, C, p, P) in terms of the policies (τ, T, b) and exogenous windfalls $(n, N).$ The policies follow from maximising politically distorted welfare, i.e. the present discounted value of utilities of within-period political objective functions:

(9) $$\underset{\tau,T,b}{\text{Max}} \quad \left[\omega(n+b,\tau)^{1-\xi} + \frac{1}{1+\rho}\Omega(N-(1+r)b,T)^{1-\xi}\right]^{\frac{1}{1-\xi}},$$

subject to (1), (2), (7) and (8), where $\xi > 0$ denotes the constant coefficient of relative intertemporal risk aversion. The optimality conditions for the tariffs are $\partial\omega / \partial\tau = 0$ and $\partial\Omega / \partial T = 0$ (as discussed in section 3.2). Public debt, *b*, follows from the politically distorted Euler equation

(10) $$\frac{\Omega}{\omega} = \left(\big(1+\Theta(b)+\Theta'(b)b\big)\frac{\partial\Omega / \partial(1+r)b}{\partial\omega / \partial b}\right)^{1/\xi}.$$

A neutral government sets $\gamma^N = \gamma^T = \gamma^W$, in which case the Euler equation (10) boils down to

(11) $$\frac{E(N,b)C(N,b)}{e(n,b)c(n,b)} = \big(1+\Theta(b)+\Theta'(b)b\big)^{1/\xi}.$$

With perfect access to international capital markets, $\Theta = 0,$ (11) indicates that it is optimal to smooth consumer expenditure, Hicksian consumption, the cost of living and the real exchange rate, i.e. $c = C,$

$e = E$ and $p = P$, and to have no tariffs, $\tau = T = 0$. However, with imperfect access to international capital markets, an interest rate premium must be paid in the face of an anticipated windfall in which case (11) indicates that consumption does not jump up as much in the anticipation period, $ec < EC$, as borrowing is constrained. The left-hand side of (11) increases in *N* and decreases in *n* and *b*. We thus see that optimal foreign borrowing, $b(n, N)$, increases in *N* and decreases in *n*. Hence, the country borrows ahead of an anticipated windfall but accumulates foreign assets during a temporary windfall.

If, in turn, the government is politically biased, $\gamma^T > \gamma^N = \gamma^W$, there may be a rationale for introducing tariffs to smooth consumption if access to capital markets is perfect (and there is no risk premium). With capital scarcity, the optimal tariff will be higher during the announcement period than during the windfall in order to achieve better consumption smoothing.

3.4. Illustration

Table 1 illustrates outcomes after an oil discovery leading to an anticipated windfall; the benchmark case corresponds to no windfall (first column in Table 1). The first two outcomes are for a windfall with perfect access to international capital markets. The undistorted case (second column) gives perfect smoothing of consumption and the real exchange rate, which is achieved by borrowing. There is no need to have tariffs. However, if the government gives more weight to capital owners in the traded sector (third column), tariffs are positive and the same before and during the windfall.

Table 1: Tariffs, borrowing and capital scarcity in face of an anticipated windfall

	No windfall	No capital scarcity		Capital scarcity	
		Neutral	Political	Neutral	Political
Profits NT sector	0.144	0.188	0.221	0.175, 0.197	0.207, 0.232
Profits T sector	0.096	0.071	0.089	0.078, 0.066	0.101, 0.081
Wage income	0.961	1.037	1.241	1.012, 1.054	1.230, 1.254
Hicksian consumption	1.144	1.395	1.393	1.322, 1.443	1.313, 1.451
Borrowing	0	**0.273**	**0.273**	**0.191**	**0.184**
Price of non-tradables	1.084	1.216	1.450	1.174, 1.244	1.420, 1.474
Tariff on tradables	0	0	**0.209**	0	**0.229, 0.195**
Cost of living index	1.050	1.124	1.323	1.101, 1.140	1.313, 1.332
Imports of tradables	-0.120	0.116	0.088	0.046, 0.162	0.012, 0.145

Notes: The four columns on the right correspond to an anticipated windfall with $n = 0$ and $N = 0.6$. The neutral outcome corresponds to $\gamma^T = \gamma^N = \gamma^W = 1/3$ and the political outcome to $\gamma^T = 1/2 > \gamma^N = \gamma^W = 1/4$. The cells indicate outcomes for both period 1 and 2, unless outcomes are the same in both periods. We use $\beta^T = \beta^N = 0, \beta^W = 1$, $y^i = {k^i}^{0.2} {l^i}^{0.8}, i = N, T$, $y(p,\tau) = \left(p^5 k^N + (1+\tau)^5 k^T\right)^{0.2}$, $w = 0.8y$, $k^N = k^T = 1$, $\xi = 2$, $e(p,\tau,q) = p^{0.6}(1+\tau)^{0.3} q^{0.1}, q = 1$ and $\rho = 0.2$. With and without capital scarcity are $\pi = 0.1b$ and $\pi = 0$. The specific functional forms employed are outlined in Appendix C.

The second two outcomes (fourth and fifth columns) show what happens under capital scarcity. For the politically neutral case (column 4), the boosts to consumption and the price of non-tradables are smaller before than during the windfall and the government borrows less due to the higher cost of borrowing. With politically distorted preferences (column 5), the tariff will be higher before than during the windfall. This alleviates capital scarcity, curbs borrowing and explains why the tariff is higher during the announcement period than during the windfall period.

4. Empirical Analysis and Baseline Results

The above model explains how an oil discovery may induce protectionism, and why the increase in tariffs may be mitigated to some extent once oil revenues pour in. It also suggests that these patterns are driven by economies in which the tradable sector is relatively dominant, and capital is scarce. In this section we provide empirical evidence in support of these hypotheses. We do so by employing a framework of country pairs of small open economies that utilises data on bilateral product-level tariffs, and discoveries of giant oil and gas fields. We first describe the data, methodology, and identification strategy. Thereafter, we present our core empirical analysis and results.

Table 2: Summary statistics of the key variables

	Mean	Std. Dev.	Min.	Max.
Ad valorem tariff, simple average (2-digit HS level, bilateral, percentage points)	11.74	10.09	0	2406
Ad valorem tariff, weighted average (2-digit HS level, bilateral, percentage points)	11.67	10.54	0	2406
Giant oil field discovery (importing country)	0.06	0.06	0	1
NPV of giant oil discoveries in percentage of GDP, realistic production profile (percentage points)	1.701	28.84	0	1130.072
NPV of giant oil discoveries in percentage of GDP, constant production profile (percentage points)	1.28	14.97	0	436.64
Democracy level (importing country)	7.52	2.34	0	10
GDP per capita (real USD)	9302.27	12564.52	140.82	82192.96
Imports per capita (2-digit HS level, bilateral, real USD)	0.39	19.66174	0	15159.12
Tradables' bargaining position	0.28	0.13	0.004	0.696
Credit constrained	0.63	0.48	0	1
Saving per capita (real USD, in thousands)	2.31	3.93	-2.463	37.26
Average tariff rate (importing country, percentage points)	11.76	6.98	0	56.73
Wildcat drillings (importing country)	12.34	42.81	0	545

Notes: For detailed description of variables see Appendix.

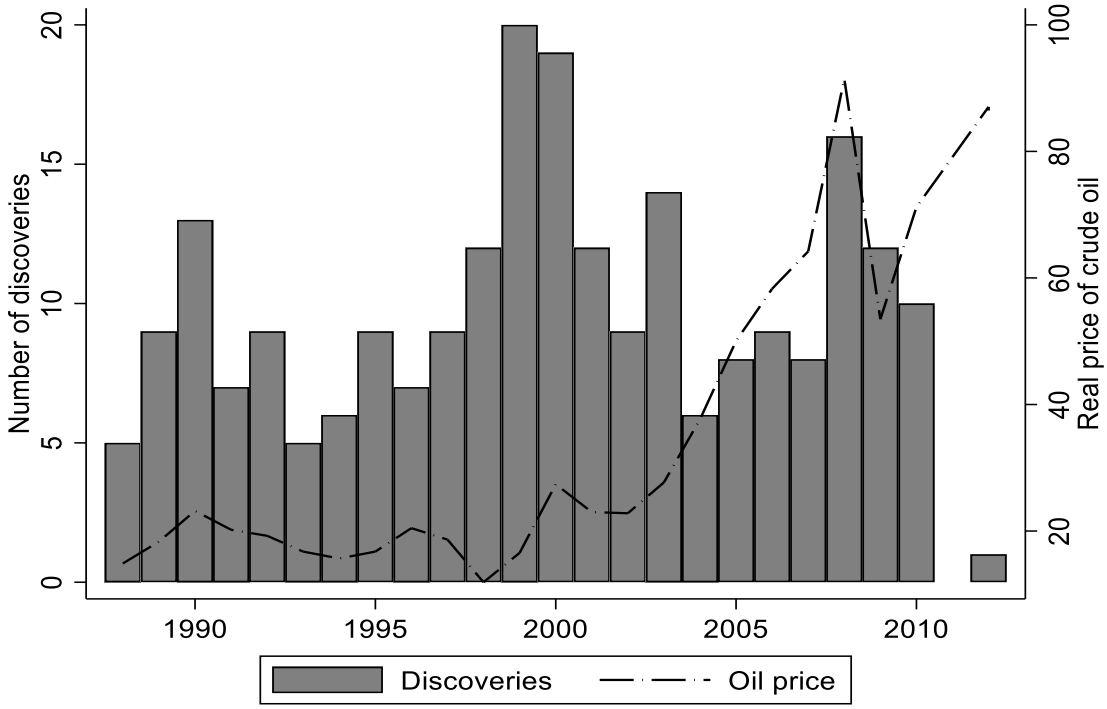
4.1. Data and methodology

Our analysis utilises two primary measures, namely oil discoveries and tariffs, in addition to further country, product, and bilateral level covariates. Next, we discuss each of these components in more detail. Further details are provided in Appendices A and B. Descriptive statistics for the key variables

are provided in Table 2 for the complete sample, and in Table A1 of Appendix A for the samples of economies with and without oil discoveries, separately.

Starting with oil discoveries, we employ data from Horn (2011) on discoveries of giant oil and gas fields, which are defined to be fields for which the estimate of ultimately recoverable oil is at least 500 million barrels of oil or gas equivalent. This data set records the location of all such discoveries across the globe up to 2012. Figure 2 presents the number of discoveries in each of the years in our sample period, illustrating their overall distribution over time. Discoveries were made in 29 countries during our sample period.[15] This group of countries represents both developed and developing economies, with relatively little difference in basic indicators, such as income and democracy levels, with the group of countries that had no discovery during the relevant time frame, as outlined in Figures 3 and 4. Discoveries were made in approximately 10% of the observations in our sample.

Figure 2: Discoveries of giant oil and gas fields, and the price of crude oil, 1988-2012



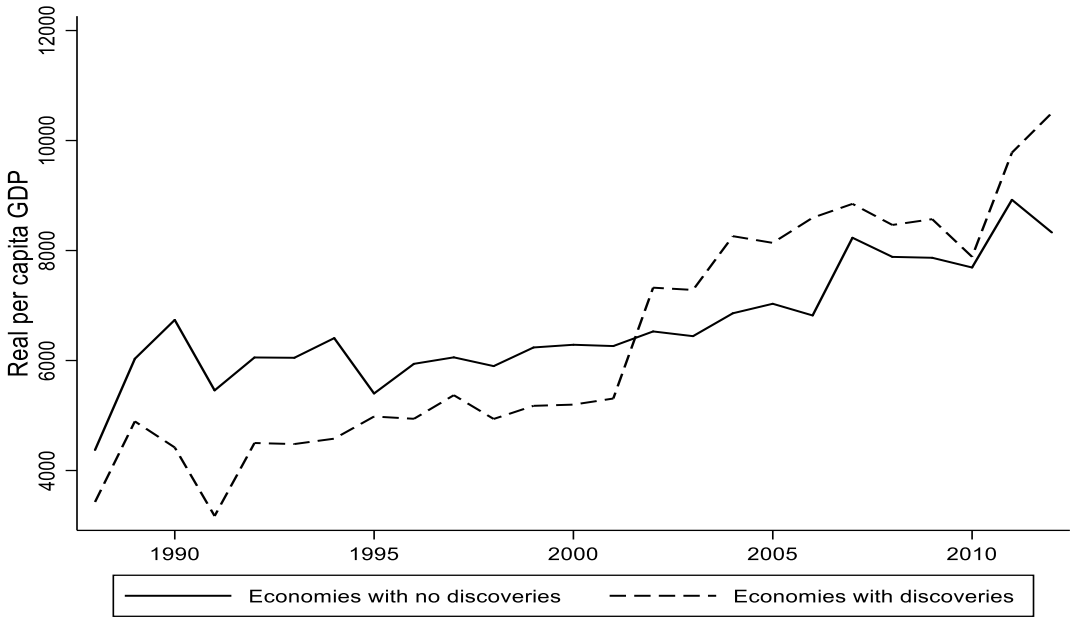
Notes: Figure presents the number of giant oil and gas field discoveries (Source: Horn (2011), and the real price of crude oil (Source: World Bank), 1988-2012.

Employing data on the discoveries of giant oil and gas fields is appealing. First, it is plausible that their timing is exogenous due to the uncertain nature of oil exploration. The latter is considered uncertain because of the relatively limited (ex-ante) knowledge of geological features of exploration locations.

[15] Appendix A lists the countries with at least one giant oil or gas field discovery during our sample period.

This feature stands at the heart of our identification strategy.[16] Second, giant oil fields provide a significant source of oil revenues, especially for smaller economies.[17] This, in turn, suggests an oil discovery represents a major economic shock. Following Perez-Sebastian and Raveh (2019), this in addition suggests that once discovered their development and exploitation are likely to be exogenous to the institutional and economic environment due to the potentially large profits they provide, which incentivise their continuous operation irrespective of the institutional and economic setting.

Figure 3: Output levels of economies with oil discoveries VS. those without, 1988-2012



Notes: Figure presents the real per capita GDP of economies with at least one discovery of a giant oil or gas field VS. those without, 1988-2012 (Source: World Bank).

Last, giant oil field discoveries have a production lag. Horn (2011) reports that oil production commences, on average, five years following the discovery. This unique feature enables examining empirically the model's key predictions concerning the separate effects of oil discoveries and oil production on protectionism.

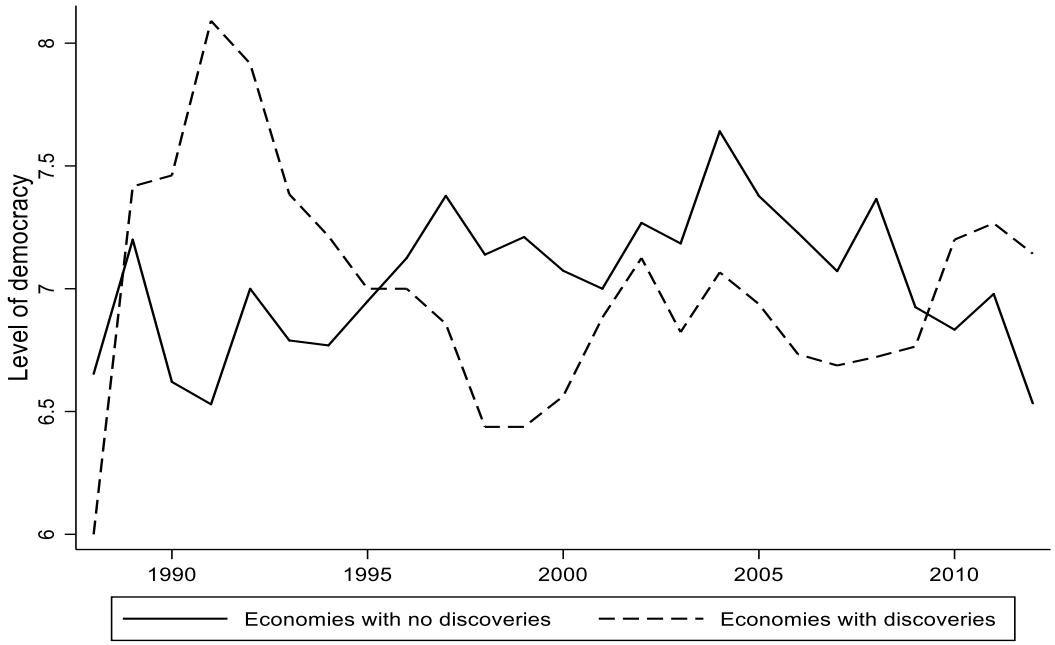
Next, data on tariffs is retrieved from the World Bank's WITS-TRAINS database, which provides detailed annual-based bilateral ad valorem equivalent tariff data at the product level for a large set of countries, starting at 1988. We utilise the full extent of this rich data set. Our main explanatory measure

[16] This identification strategy was adopted by previous studies that examined the effects of oil discoveries, including Arezki et al. (2017), Cotet and Tsui (2013), Lei and Michaels (2011), and Perez-Sebastian and Raveh (2016), among others. We consider several aspects of this assumption, including for instance the potential underlying role of exploration efforts and the potential endogeneity of subsequent discoveries. As an initial step we include in Figure 1 the evolution of the oil price over time, which does not point at a systematic association with the number of discoveries.

[17] For instance, Arezki et al. (2017) report that the mean value of the GDP share of the net present value of a giant oil field discovery is about 67% and can get higher than 6000% (the case of Qatar).

in the analysis is the average bilateral ad valorem tariff for 96 products (2-digit HS level), [18] in 155 small open economies.[19] Figure 5 plots the average tariff level across our sample period for the group of countries that experienced oil discoveries throughout the given period, and for the group of countries that have not. The graph illustrates the general downward trend over time; the average tariff level worldwide in 1988 was around 15%, while in 2012 it reduced to below 10%.[20] Importantly, the trend in the two groups is similar, suggesting that the patterns we examine in the analysis are not an outcome of distinct liberalisation trends.

Figure 4: Democracy levels of economies with oil discoveries VS. those without, 1988-2012



Notes: Figure presents the level of democracy (Polity IV index) of economies with at least one discovery of a giant oil or gas field VS. those without, 1988-2012 (Source: Polity IV).

Last, the analysis in addition includes covariates. The ones that are included in all the specifications are real per capita GDP and democracy levels (measured via the standard Polity IV index) of the reporting and partner economies, and the two basic bilateral controls in gravity frameworks, namely distance (great circle) and the existence of a border (henceforth, *controls*). These measures control for some of the fundamental determinants of country-level and bilateral tariffs, namely their income level, institutional quality, and proximity to its partner country. They appear in the specification in the

[18] The tariffs across 2-digit HS level products are calculated as averages of the reported tariffs at the 6-digit HS levels. Later in the analysis we also test for robustness a similar tariff measure calculated as a weighted average, with the weights being the import shares of sub-2-digit products and show that the main results are not sensitive to this difference. We adopt the former measure as the primary one due to its significantly larger availability.

[19] The complete list of countries included in the sample is outlined in the Appendix A. Due to our focus on small open economies, the U.S. and EU economies are excluded from the sample.

[20] Approximately 10% of the tariffs are set at 0%. In a later sub-section we show, as a robustness test, that the main results hold when these tariffs are excluded.

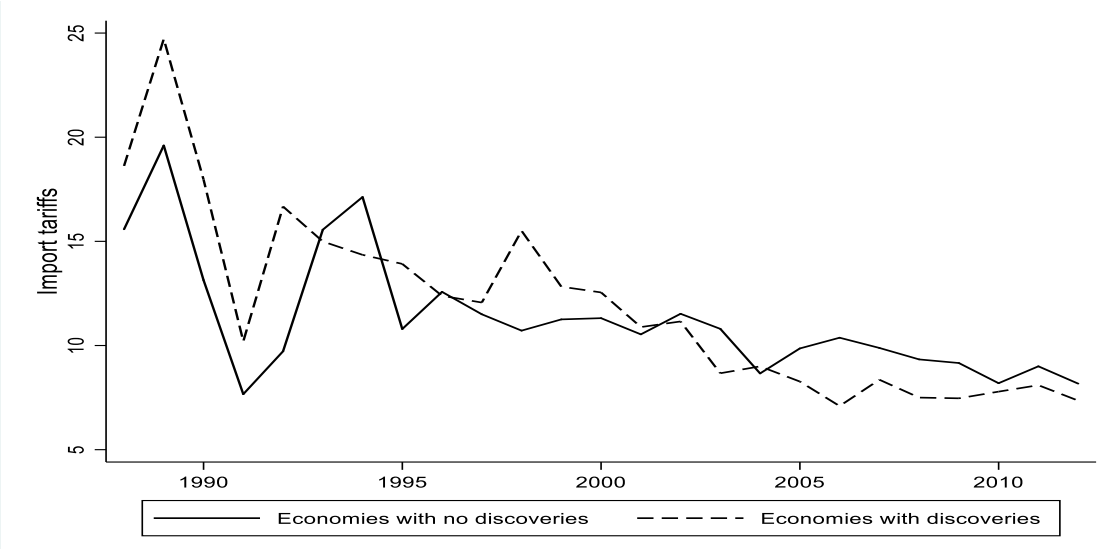
precedent period ($t-1$), to mitigate concerns related to potential endogeneity. Throughout the analysis we employ additional controls at the country, product, and bilateral levels, which we describe separately when discussing the corresponding specification along the analysis.

To examine the effect of the exogenous variation in the discovery and exploitation of giant oil and gas fields on bilateral product-level tariffs, we estimate variations of the following fixed effects model

$$\tau_{m,x,p,t} = \alpha + \beta D_{m,t\in[t,t-10]} + \boldsymbol{\gamma X}_{v\in(m,x,p),t-1} + \delta_m + \mu_x + \pi_p * \theta_t + \epsilon_{m,x,p,t}, \quad (12)$$

where τ is the average tariff rate, reported by importing country m, for product p with $p \in [1,96]$ originating from country x, at year $t \in [1988, 2012]$; $\boldsymbol{X}$ is a vector of controls that includes the previously outlined *controls*, in addition to other case-specific measures at the m, x, or p levels; δ, μ, and $\pi * \theta$ are importer, exporter, and product by year fixed effects respectively, which control for fixed unobserved heterogeneity at the importer, exporter, and year-specific product levels such as for instance product-specific shocks across time, or more general global shocks such as changes in the price of oil. Accounting for the latter contributes to identifying the effect of our treatment because unobserved variations in demand, supply, and technology changes across products, which are potentially important tariff determinants, are effectively controlled for. Last is D, which denotes the treatment effect, namely the discovery of a giant oil or gas field in the importing country sometime between year t and $t-10$ (depending on the specification). In our analysis D is a binary measure that captures the occurrence of a discovery. Given that discoveries are defined to be large, we do not exploit further variation related to the more specific (expected) size of the discovery due to the potential measurement errors involved.[21]

Figure 5: Import tariffs of economies with oil discoveries VS. those without, 1988-2012



Notes: The figure presents the level of import tariffs of economies with at least one discovery of a giant oil or gas field VS. those without, 1988-2012 (Source: TRAINS-WITS).

[21] Nonetheless, we also test measures that account for the more specific size characteristics of the discovery and show that the main results are not sensitive to their usage.

Standard errors are assumed to correlate within products and country pairs, and hence are clustered at that level in all specifications. Our focus is on the sign, magnitude, and statistical preciseness of the coefficient on *D*, i.e. β, which provides an estimate of the effect of a giant oil or gas field's discovery and production on the extent of protectionism.[22]

4.2. Baseline results

We start by examining the dynamic effects of oil discoveries on the tariff level over a 10-year period. Such a time frame includes both the pre-production years (0-4) together with the early post-production ones (5-10). To do so, we estimate the following version of equation (12):

$$(13) \qquad \tau_{m,x,p,t} = \alpha + \sum_{j=1}^{11} \beta_j D_{m,t+1-j} + \boldsymbol{\gamma X}_{v\in(m,x,p),t-1} + \delta_m + \mu_x + \pi_p * \theta_t + \epsilon_{m,x,p,t},$$

where $D_{m,t+1-j}$ is one if a discovery took place in year $t + 1 - j$ and zero otherwise. The number of observations is slightly higher than 800,000, with R^2 of about 0.46. Figure 6 plots the βs, together with their 95% confidence intervals. The results indicate that upon discovery tariffs increase continuously up to the fourth year; however, starting in the fifth year, when production commences, tariffs are reduced continuously over the following four years by a lower magnitude than the initial increase, with the reduction wearing off around the tenth year. These patterns provide some initial empirical affirmation for our main hypotheses, as well as for the model's predictions for politically biased and capital scarce economies, as they indicate that prior to the start of oil production tariffs increase. Once production commences, this increase is mitigated, leaving tariffs higher than before the oil discovery.

Since we are not interested in the effect of one particular period but in the patterns induced in the discovery years versus those that occur in the post-production period, we next estimate the following benchmark version of equation (12):[23]

$$(14) \qquad \tau_{m,x,p,t} = \alpha + \beta_1 Disc_{m,T} + \beta_2 Prod_{m,T-1} + \boldsymbol{\gamma X}_{v\in(m,x,p),t-1} + \delta_m + \mu_x + \pi_p * \theta_t + \epsilon_{m,x,p,t},$$

where *T* denotes a 5-year period, between *t* and $t - 4$, and equivalently $T - 1$ for the precedent 5-year period between $t - 5$ and $t - 9$; in addition, *Disc* (*Prod*) is a binary variable that indicates whether a discovery occurred during the period *T* ($T - 1$). Therefore, *Disc* represents the discovery period (years 0 to 4 from discovery), while *Prod* denotes the production period (years 5 to 9). The characteristics of β_1 and β_2 provide an estimate of the distinctive effects of the two periods on the pattern of changes in tariffs over time.[24]

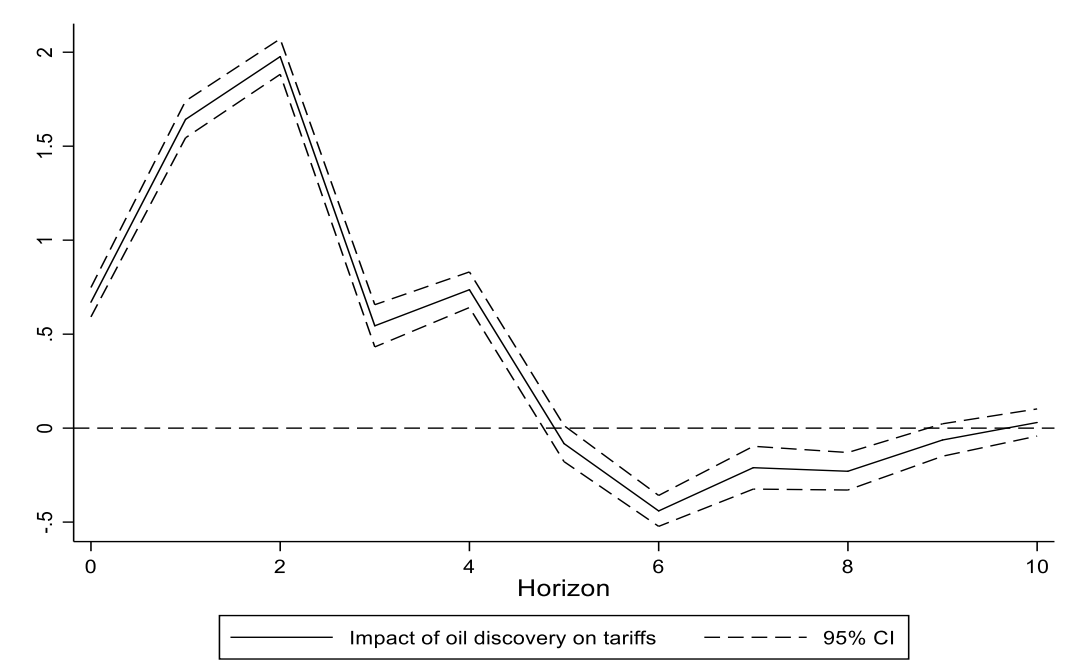
[22] The coefficient β gives the marginal impact of a discovery on tariffs. A positive (negative) β suggests that a discovery induces an increase (decrease) in the average tariff level. We also test a dynamic specification, equivalent to considering the dependent variable in changes, and discuss its interpretation.

[23] We follow the methodology of Arezki et al. (2017) who examined the effects of aggregate, post-discovery periods to compare more directly between the pre- and post-production effects.

[24] Importantly, while the sample period begins in 1988 the giant oil field data is available for earlier periods; hence, *Disc* and *Prod* are constructed for the complete sample period, starting in 1988, despite being based on discoveries prior to the start year of the panel.

The results are shown in Table 3. In columns 1 and 2 we include *Disc* and *Prod* separately. The estimated βs indicate that tariffs increase in the pre-production years but fall in the post-production ones, in line with the hypothesis put forward in section 3. The difference in magnitudes suggest that the post-production decrease does not cancel the earlier increase; hence, overall a discovery of a giant oil or gas field increases the degree of protectionism and international disintegration by some extent.

Figure 6: Baseline dynamic patterns, 10-year horizon



Notes: Figure illustrates the impact of oil discoveries on tariffs over time by plotting the estimated βs from equation (13) with a 95% confidence interval.

To better interpret the magnitudes, in column 3 we examine the baseline specification, in which both *Disc* and *Prod* are included concurrently (as in equation 14). The signs, magnitudes, and significance are similar to those obtained under the initial dynamic estimation, presented in Figure 6. The absolute and relative size of the βs indicate that a discovery of a giant oil or gas field on average increases the tariff rate by 0.64 percentage points in each of the first, pre-production five years, and decreases it thereafter by 0.28 percentage points in each of the following five years once production takes place.[25] Hence, overall an oil discovery induces an increase of 1.8 percentage points in the average tariff over the course of 10 years, which amounts to a 15% increase in the average tariff. To examine whether this is driven by differences in the initial tariff levels, in the last, fourth column we estimate a dynamic version of column 3, in which the lagged dependent variable is added as a regressor.[26] This case, which

[25] The βs give the average annual effect because the shocks we examine, within the given periods, are annual (as opposed to examining, for instance, the overall average shocks within the inspected timeframe).
[26] This is equivalent to a specification where the dependent variable is in changes and convergence in tariff rates is controlled for. In addition, the estimates in this case may be affected by the Nickell bias (Nickell, 1981); however, under the relatively long sample period we adopt the potential bias of order $1/T$ is seemingly negligible.

controls for the initial tariff level, yields qualitatively similar results; oil discoveries, thus, induce protectionism that is reduced once oil production is started, irrespective of its initial level.[27]

Table 3: Baseline results

Dependent variable: Average tariff	(1)	(2)	(3)	(4)
	Discovery	Production	Baseline	Dynamic
Discovery	0.67***		0.64***	0.33***
	(0.02)		(0.02)	(0.03)
Production		-0.35***	-0.28***	-0.39***
		(0.03)	(0.03)	(0.02)
Average tariff $(t-1)$				0.51***
				(0.05)
Importer and exporter fixed effects	Yes	Yes	Yes	Yes
Product-by-year fixed effects	Yes	Yes	Yes	Yes
R-squared, adjusted	0.404	0.404	0.404	0.56
Observations	2850054	2850054	2850054	2847849

Notes: Standard errors are robust, clustered by country pairs and products and appear in parentheses for independent variables. Superscripts *, **, *** correspond to a 10, 5 and 1% level of significance. Sample includes country pairs of 155 small open economies, across 96 (2-digit HS codes) products, over the period 1988-2012. The dependent variable is the average, ad-valorem tariff rate. 'Discovery' ('Production') is a dummy variable that indicates whether a discovery of a giant oil or gas field occurred within the precedent 4 years (5 to 9 years). All regressions include in addition an intercept, and the following controls (in t-1): importer/exporter real per capita GDP and democracy levels, bilateral distance (great circle), and an indicator for common border. For further information on variables, see Appendix A.

4.3. Underlying mechanism of baseline results: imports, tradables, and credit constraints

The baseline results provided some empirical support for the key theoretical predictions, namely that oil discoveries increase the extent of protectionism due to an initial steep rise that is mitigated once oil production begins. In this sub-section we dig deeper into the suggested underlying mechanism. The model proposes a political approach under which the observed patterns are driven by exporters and primarily in capital scarce economies in which the tradable sector is relatively dominant. Next, we provide evidence in support of these assertions. Results appear in Table 4.[28]

First, we motivate the relevance of the political approach, and the assertion that the demand for protectionism is driven primarily by exporters. While tariffs provide protection, they are also a fiscal instrument for raising public revenues. To examine whether in our case the increase in the rate of tariffs is driven by fiscal or political motives, and whether these motives are triggered primarily by exporters, we focus on the role of imports. Specifically, we conjecture that if the observed tariff increases are within imported products then the motivation for the increase may be represented via either the fiscal or political reasons, and triggered by either importers or exporters; however, if those increases occur strictly within products which are either not imported, or imported in negligible amounts, then the tariff

[27] Two years past the shock the rate of change in the tariff rate turns negative, despite the positive effect in levels (see Figure 6); hence, the rate of change is on average slightly higher in absolute value during production years.
[28] The number of observations may differ across cases based on the availability of data related to the specific measures inspected in each case.

increases are primarily undertaken to induce protection to goods that already have a relatively favourable trade balance, consistent with the proposed theory, notwithstanding the concurrent increase in tariff revenues it nonetheless yields as a result.[29]

To test this conjecture, we match the tariff data with bilateral import data at the 2-digit HS level for our sample period.[30] Our focus is on the real partner-by-product specific imports per capita. In columns 1 and 2 we estimate the baseline specification (column 3 of Table 3) for two separate sub-samples of the complete panel, which is divided based on the average level of the said imports per capita measure. Column 1 examines the sub-sample of product-year cases in which imports are higher than the mean (of which about 75% have zero imports), whereas column 2 examines the cases in which imports are lower than the mean (which compose approximately 5% of the complete sample). The estimated β_1's indicate that the tariff increases following discoveries occur strictly in the less-imported products, in which the increase is significantly steeper; in the highly-imported products β_1 is close to zero and non-significant. This, in turn, motivates our political perspective, and the asserted role of exporters, to rationalise the observed pre-production tariff increases. During oil production years, tariffs decrease in both cases, supporting the generality of the negative association between oil *revenues* and tariffs, suggested by the model.

Table 4: Imports, tradables, and credit constraints

Dependent variable: Average tariff	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Imports		Tradables		Credit constraints		Both	
	Above	Below	Below	Above	Non-constrained	Constrained	Below	Above
Discovery	0.09	0.66***	-0.7***	0.93***	-0.05	0.81***	-0.53***	0.61***
	(0.08)	(0.02)	(0.06)	(0.05)	(0.05)	(0.02)	(0.04)	(0.03)
Production	-0.73***	-0.24***	-1.12***	-0.14***	-0.43***	-0.18***	-0.09	-0.45***
	(0.07)	(0.03)	(0.06)	(0.03)	(0.05)	(0.04)	(0.07)	(0.04)
Importer and exporter fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Product-by-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared, adjusted	0.61	0.39	0.44	0.46	0.49	0.35	0.54	0.39
Observations	133338	2716641	522843	548320	833242	1817021	445835	2404219

Notes: Standard errors are robust, clustered by country pairs and products and appear in parentheses for independent variables. Superscripts *, **, *** correspond to a 10, 5 and 1% level of significance. The complete sample includes country pairs of 155 small open economies, across 96 (2-digit HS codes) products over the period 1988-2012. In regressions 1-2/3-4/5-6/7-8 the sample is divided based on the extent of product-level imports, bargaining power of the tradable sector, financial constraints, and interaction of the latter two (the division criteria and description of these measures are outlined in the text and Appendix A). The dependent variable is the average, ad-valorem tariff rate. 'Discovery' ('Production') is a dummy variable that indicates whether a discovery of a giant oil or gas field occurred within the precedent 4 years (5 to 9 years). All regressions include in addition an intercept, and the following controls (in t-1): importer/exporter real per capita GDP and democracy levels, bilateral distance (great circle), and an indicator for common border. For further information on variables see Appendix A.

[29] In Appendix D we examine the impact of oil discoveries on tariff revenues, showing that tariffs are increased in products that are located on the left side of the Laffer Curve for tariff revenue, consistent with the consumption smoothing perspective adopted in the theoretical framework.

[30] This data is retrieved from the UN-Comtrade database. See Appendix A for further details.

Second, we consider the relative dominance of the tradable sector. To do so, we construct a simple interaction measure between the GDP share of the manufacturing sector of country *m* and its *LAMRIG* index level (Campus and Nugent, 2012), at year *t*. The former proxies for the relative size of the tradable sector in the economy, whereas the *LAMRIG* index level captures the rigidity of employment protection legislation, and hence the relative political strength of the labour market (e.g. Saint-Paul (2004)). Their interaction provides a proxy for the relative bargaining power of the tradable sector, because large sectors under rigid labour markets might be expected to be economically and politically influential. We use this measure to divide the sample based on its average value. Column 3 (4) estimates the baseline model for the sub-sample of countries with a value lower (higher) than the average. The results indicate that oil-induced protectionism seems to be present mainly in economies with a dominant tradable sector; conversely, in the remaining economies tariffs are reduced following an oil discovery. These patterns are consistent with those produced under the numerical illustration of the model.[31]

Third, while there are various approaches to measuring the extent of credit constraints, we take a broad perspective that enables a cross-sectional division by directly observing whether such constraints have been acknowledged by international organisations. Hence, we construct a binary variable that takes a positive value if the country received financial assistance from the World Bank or other similar international organisations during the sample period, in which case we assign it to be credit constrained. Based on this measure, we estimate in columns 5 and 6 the baseline case for the two sub-samples of economies that are not and that are credit constrained, respectively. The estimates on the pre-oil-production period is clearly divided; tariffs steeply increase in the constrained sub-sample, yet do not react in the non-constrained one. In the post-oil-production period, however, tariffs drop in both cases. These patterns point to the role of capital scarcity in driving protectionism, consistent with the theoretical analysis, noting that this division includes politically distorted economies.

Last, we examine the case in which the latter two measures are interacted. This design enables looking into the impact of oil discoveries on the tariffs of economies with a dominant tradable sector *and* financial constraints more specifically, which as noted by the model is of particular interest. In columns 7 and 8 we estimate separately the sub-samples in which the value of this measure of below and above its mean, respectively. The results are consistent with those produced under the numerical assessment of the model. Specifically, we notice that the tariff increase (decrease) in the pre(post)-oil-production phase is specific to financially constrained economies with a dominant tradable sector, while in the remaining economies tariffs tend to decrease without changing differentially across pre-post production periods.

[31] To the extent that sectoral dominance is associated with the extent of lobbying, these results are consistent with the association between lobbying and protectionism proposed by Grossman and Helpman (1994).

5. Robustness

We now investigate how our baseline results are affected by real GDP per capita, democracy, saving, openness and distance (section 5.1), effects on different economic sectors (section 5.2), and robustness with respect to different measures for tariffs and giant oil and gas field discoveries (section 5.3), different lengths of pre-production periods (section 5.4) and some additional factors (section 5.5).

5.1. Heterogeneous effects

To better understand the patterns of tariff changes, we next undertake a heterogeneity analysis, with a number of key measures. To do so, we estimate the following version of equation (14):

$$(15)\quad T_{m,x,p,t} = \alpha + \beta_1 Disc_{m,T} + \beta_2 Prod_{m,T-1} + \beta_3\left(Disc_{m,T} * C_{m,t-5}\right) + \beta_4(Prod_{m,T-1} * C_{m,t-10}) + \beta_5 C_{m,t-5} + \beta_6 C_{m,t-10} + \boldsymbol{\gamma X}_{v\in(m,x,p),t-1} + \delta_m + \mu_x + \pi_p * \theta_t + \epsilon_{m,x,p,t},$$

where C is the measure examined, which changes across the different specifications. To mitigate concerns related to endogeneity of the measure C, we interact its level in the year prior with the initial one in each of the discovery and production periods. Hence, in the case of *Disc* (*Prod*), which examines years 0-4 (5-9), the interacted *C* is in $t-5$ ($t-10$). The econometric results are shown in Table 5.[32]

In column 1 we test the case of output, measured via real per capita GDP. The association between trade policy and income has been studied extensively (see e.g. Edwards, 1997). We examine its association when interacted with an oil discovery. The results on β_1 and β_2 indicate that the main patterns still hold, whereas those on β_3 and β_4 suggest that the extent of both the initial protectionism and its later mitigation are stronger in low income economies. These patterns are consistent with previous evidence on the key role of capital scarcity, given the tight link between the latter and the level of income.

Column 2 investigates the role of the degree of democracy. Cust and Harding (2019) find that exploration efforts are endogenous to the level of institutional quality, implying that the latter may represent a key underlying channel. We let *C* denote the level of democracy, measured via the standard Polity IV index (under which the index level is positively associated with the extent of democracy). The estimated βs suggest that the main patterns on discovery and production still hold, while the heterogeneous impacts point at stronger effects in economies with relatively low levels of democracy. While this may be due to the notion that autocracies may facilitate changes in trade policies due to the centralised institutions and low transparency, this may also follow from the previously discussed credit-constraint channel which might be more prominent in non-democratised economies.

Next, we examine the role of saving. Our analytical model suggests that tariffs increase in economies facing capital scarcity as their attempts to smooth consumption may be frustrated when the option to

[32] The number of observations may differ across cases based on the availability of data related to the specific measures inspected in each case.

borrow is limited; hence, the extent of the estimated patterns of the effects of discoveries on tariffs over time may depend on the ability to save. In addition, saving may be endogenous to oil discoveries (Arezki et al., 2017), and hence may represent a potential transmission channel. We test the viability of these points in column 3, in which *C* represents real saving per capita. While the coefficients on *Disc* and *Prod* indicate that the main patterns still hold, the estimates on β_3 and β_4 indicate that the discovery and production patterns are more pronounced in economies in which saving is facilitated.

Table 5: Heterogeneous effects

Dependent variable: Average tariff	(1)	(2)	(3)	(4)	(5)
	Output	Democracy	Saving	Openness	Distance
Discovery	5.14***	0.76***	0.25***	1.24***	0.38***
	(0.43)	(0.07)	(0.11)	(0.08)	(0.09)
Production	-7.64***	-0.63***	-0.75***	-0.42***	-0.32***
	(0.37)	(0.06)	(0.06)	(0.08)	(0.06)
Discovery * X_(*t-5*)	-0.58***	-0.04***	-0.11***	-0.01*	0.03***
	(0.05)	(0.002)	(0.04)	(0.008)	(0.007)
Production * X_(*t-10*)	0.95***	0.16***	0.46***	0.01*	0.03***
	(0.04)	(0.009)	(0.03)	(0.006)	(0.007)
Importer and exporter fixed effects	Yes	Yes	Yes	Yes	Yes
Product-by-year fixed effects	Yes	Yes	Yes	Yes	Yes
R-squared, adjusted	0.43	0.43	0.42	0.44	0.43
Observations	1090346	1090346	1004238	1090346	1090346

Notes: Standard errors are robust, clustered by country pairs and products and appear in parentheses for independent variables. Superscripts *, **, *** correspond to a 10, 5 and 1% level of significance. The complete sample includes country pairs of 155 small open economies, across 96 (2-digit HS codes) products over the period 1988-2012. In regressions 1-4 (5) 'X' is the output per capita, democracy level, saving per capita, and average overall tariff level of the importing country, respectively (bi-lateral distance). The dependent variable is the average, ad-valorem tariff rate. 'Discovery' ('Production') is a dummy variable that indicates whether a discovery of a giant oil or gas field occurred within the precedent 4 years (5 to 9 years). All regressions include in addition an intercept, and the following controls (in t-1): importer/exporter real per capita GDP and democracy levels, bilateral distance (great circle), and an indicator for common border. For further information on variables see Appendix A.

In column 4 we test the role of trade openness. Arezki et al. (2019) find that the extent of oil discoveries is endogenous to the degree of market orientation or openness, which may affect the viability and extent of the main effects. More generally, economies that adopt trade-enhancing policies may adjust their extent of protectionism differently than economies that tend to implement greater barriers when facing an oil discovery. Hence, in this case *C* is the overall average ad valorem tariff level in the economy, which proxies for the initial level of openness and the extent of market orientation. The results indicate that while the main intertemporal patterns for changes in tariffs remain to hold, the heterogeneous impacts appear negligible given the weak precision and low magnitude. The effects of oil discoveries on the patterns of trade policies are similar across openness levels.

Last, we examine the primary determinant of bilateral trade, namely distance. In column 5 we use our measure of bilateral distance as *C*. The results on β_1 and β_2 are akin to the baseline case, hence the main results for the changes in tariffs over time are robust to this addition. Interestingly, the estimates of β_3 and β_4 indicate that the extent of the effect changes with distance. Specifically, the extent of protectionism increases with distance, and the extent of its reduction during later periods diminishes

with distance. These patterns strengthen the motivation behind the adoption of a political approach. While revenues from tariffs may be higher for lower distances, due to the higher trade volumes of proximity, the political cost of implementing barriers may be high. Conversely, if the partner is far away, tariff revenues may be marginal, yet the sale of protection may be facilitated if strategic interests weaken with distance.

5.2. Effects of discoveries on tariffs at the sector level

Next, we test whether the observed patterns of changes in tariffs are different across sectors. To do so, we examine aggregates of the 2-digit HS sectors into the standard 14 main HS sectors, ranging from animal and mineral products to metals and machinery. The list of groups and their composition of 2-digit sectors are outlined in Appendix A. We estimate the baseline specification (column 3 of Table 3) for each group separately. The econometric results are shown in Table 6.

Table 6: Sector analysis

Dependent variable: Average tariff	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Animal products	Foodstuffs	Mineral products	Chemicals	Plastics	Raw hides and leather	Wood products
Discovery	1.17***	0.68***	0.63***	0.9***	1.06***	0.7***	0.76***
	(0.14)	(0.11)	(0.17)	(0.08)	(0.13)	(0.14)	(0.15)
Production	-1.09***	-0.75***	-0.55***	-0.68***	-0.63***	-0.54***	-0.49**
	(0.18)	(0.12)	(0.17)	(0.08)	(0.14)	(0.14)	(0.22)
Importer and exporter fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Product-by-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared, adjusted	0.45	0.3	0.44	0.48	0.46	0.53	0.19
Observations	73882	394833	61226	281875	86632	51830	137041
Dependent variable: Average tariff	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	Textiles	Footwear	Stone and glass	Metals	Machinery	Transportation	Optical apparatus
Discovery	0.5***	0.31***	0.47***	0.45***	0.35***	0.47***	0.36***
	(0.05)	(0.08)	(0.07)	(0.05)	(0.08)	(0.09)	(0.06)
Production	-0.32***	-0.25*	-0.09	-0.03	-0.14	-0.24*	-0.19**
	(0.06)	(0.13)	(0.11)	(0.08)	(0.14)	(0.13)	(0.09)
Importer and exporter fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Product-by-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared, adjusted	0.5	0.53	0.5	0.47	0.39	0.51	0.49
Observations	416892	121612	190146	383995	187781	125200	337109

Notes: Standard errors are robust, clustered by country pairs and products and appear in parentheses for independent variables. Superscripts *, **, *** correspond to a 10, 5 and 1% level of significance. The complete sample includes country pairs of 155 small open economies, across 96 (2-digit HS codes) products over the period 1988-2012, restricted in each of the regressions to one of the main 15 HS sectors (outlined in Appendix A). The dependent variable is the average, ad-valorem tariff rate. 'Discovery' ('Production') is a dummy variable that indicates whether a discovery of a giant oil or gas field occurred within the precedent 4 years (5 to 9 years). All regressions include in addition an intercept, and the following controls (in t-1): importer/exporter real per capita GDP and democracy levels, bilateral distance (great circle), and an indicator for common border. For further information on variables see Appendix A.

Interestingly, the patterns of the effects in tariffs before and after oil production starts are quite similar across sectors. In fact, the increase in the extent of protectionism in pre-production years is apparent in all sectors, and the mitigation after oil production has started is apparent in most. Overall, over the course of 10 years, oil discoveries increase tariffs in each of the separate sectors. The difference lies in the magnitudes. In the animal products, chemicals, and plastics sectors tariffs increase most strongly in the pre-production years; however, they also represent the sectors with some of the steepest declines in the post-production period. Overall, the sectors in which the extent of protectionism rises most sharply during the 10-year period are plastics, stone and glass, metals, and machinery.

5.3. Robustness with respect to different measures for tariffs and discoveries

Our two primary measures are tariffs and giant oil and gas field discoveries. In this sub-section we examine the robustness of the main results to using different forms of these two measures. In all cases we follow the baseline specification as in column 3 of Table 3. The results are shown in Table 7.

Table 7: Different measures

	(1)	(2)	(3)	(4)
	Tariffs		Discoveries	
	Weighted	Logarithm	NPV - projected	NPV - constant
Dependent variable:	Tariff, weighted-average	Natural logarithm of average tariff	Average tariff	Average tariff
Discovery	1.63***	0.03***		
	(0.02)	(0.002)		
Production	-0.15***	-0.07***		
	(0.03)	(0.002)		
Discovery_NPV			0.89***	
			(0.02)	
Production_NPV			-0.07***	
			(0.01)	
Discovery_NPV_constant				0.88***
				(0.02)
Production_NPV_constant				-0.06***
				(0.02)
Importer and exporter fixed effects	Yes	Yes	Yes	Yes
Product-by-year fixed effects	Yes	Yes	Yes	Yes
R-squared, adjusted	0.43	0.56	0.4	0.4
Observations	2431976	2850054	2850054	2850054

Notes: Standard errors are robust, clustered by country pairs and products and appear in parentheses for independent variables. Superscripts *, **, *** correspond to a 10, 5 and 1% level of significance. The complete sample includes country pairs of 155 small open economies, across 96 (2-digit HS codes) products over the period 1988-2012. The dependent variable is the average ad-valorem tariff rate (columns 3-4), weighted-average ad-valorem tariff rate (column 1), or the natural logarithm of the average ad-valorem tariff rate (column 2). 'Discovery' ('Production') is a dummy variable that indicates whether a discovery of a giant oil or gas field occurred within the precedent 4 years (5 to 9 years). 'Discovery_NPV[_constant]' ('Production_NPV[_constant]') is the net present value of discoveries [under constant production profile] within the precedent 4 years (5 to 9 years). All regressions include in addition an intercept, and the following controls (in t-1): importer/exporter real per capita GDP and democracy levels, bilateral distance (great circle), and an indicator for common border. For further information on variables, see Appendix A.

We test whether our results still hold if two alternative measures of tariffs are used. First, we examine the weighted average version of the product-level bilateral ad valorem equivalent tariffs, with the weights in each 2-digit product being the import shares of its sub, 6-digit products.[33] While this measure yields more accurate 2-digit level tariffs compared to the simple average case, its coverage is more limited and restricts the sample to some extent. Second, we test the baseline tariff measure in its natural logarithm form, which allows us to test whether our results are driven by outliers.[34] The results in columns 1 and 2 suggest that both cases produce patterns in changes in tariffs following news of a giant oil or gas discovery that are qualitatively akin to those obtained in the baseline case.

As for giant oil discoveries, we test the two measures constructed by Arezki et al. (2017). Both are based on the net present value of the giant oil and gas field discoveries, computed based on the estimated recoverable number of oil barrel equivalents provided by Horn (2011), country-specific discount rates, and underlying production profiles which are either projected or kept constant. The two cases appear in columns 3 and 4, respectively. The results in either case indicate that the main patterns still hold and hence appear to be robust if these alternative measures of discoveries are used.

5.4. Robustness with respect to different length of pre-production periods

In the baseline analysis we assume that the pre-production period is 5 years, based on the average period reported by Horn (2011). Conversely, Arezki et al. (2017) indicate that this period may be shorter or longer, depending on whether the discovered oil field is onshore or offshore. Similarly, the average number of pre-production years may be affected by additional common factors. Hence, in this sub-section we test the robustness of our baseline results to different pre-production periods. In addition, we also conduct a placebo test to examine whether tariffs respond to the discovery in the pre-discovery period; if our hypothesis is correct and discoveries are truly unanticipated, they should not.

Results appear in Table 8. All cases follow the baseline specification (column 3 of Table 3) with the difference of considering different *Disc* and *Prod* measures. In columns 1-5, *Disc* (*Prod*) refers to the period of t to t–2/t–3/t–5/t–6/t–7 (t–3/t–4/t–6/t–7/t–8 to t–9), respectively; hence, representing the cases of pre-production periods of 3, 4, 6, 7, and 8 years, respectively. In all cases the post-production period ends 9 years after the discovery. The results indicate that the main patterns are robust to the adoption of different pre-production period lengths. Notably, in all cases tariffs increase in the pre-production period and decrease thereafter. As expected, the magnitude of the average pre-(post-)production increase (decrease) drops (increases) with the length of the pre-production period.

In column 6 *Disc* refers to the period of t+1 to t+4 (and *Prod* is excluded). This specification examines the patterns of tariffs prior to the discovery. The coefficient on *Disc* in this case is close to zero and is

[33] Data is retrieved from the World Bank's WITS-TRAINS database.
[34] To enable transformation for the complete sample we added one percentage point to all tariffs prior to conversion.

not statistically significant, further supporting the conjecture that tariffs react to unanticipated discoveries of giant oil and gas fields.

Table 8: Different aggregate periods

Dependent variable: Average tariff	(1)	(2)	(3)	(4)	(5)	(6)
	3-year	4-year	6-year	7-year	8-year	pre-discovery
Discovery	0.67***	0.65***	0.62***	0.57***	0.49***	
	(0.03)	(0.03)	(0.03)	(0.03)	(0.02)	
Production	-0.1***	-0.29***	-0.69***	-0.84***	-0.85***	
	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)	
Pre-discovery						0.006
						(0.02)
Importer and exporter fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Product-by-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R-squared, adjusted	0.404	0.404	0.405	0.405	0.405	0.403
Observations	2850054	2850054	2850054	2850054	2850054	2850054

Notes: Standard errors are robust, clustered by country pairs and products and appear in parentheses for independent variables. Superscripts *, **, *** correspond to a 10, 5 and 1% level of significance. The complete sample includes country pairs of 155 small open economies, across 96 (2-digit HS codes) products over the period 1988-2012. The dependent variable is the average, ad-valorem tariff rate. In regressions 1/2/3/4/5 [6] 'Discovery' ('Production') ['Pre-discovery'] is a dummy variable that indicates whether a discovery of a giant oil or gas field occurred within the precedent 2/3/5/6/7 years (3/4/6/7/8 to 9 years) [following 4 years], respectively. All regressions include in addition an intercept, and the following controls (in *t*-1): importer/exporter real per capita GDP and democracy levels, bilateral distance (great circle), and an indicator for common border. For further information on variables see Appendix A.

5.5. Additional robustness tests

Table 9 reports some additional robustness tests. All cases estimate various variations of the baseline specification (column 3 of Table 3). First, we consider the role of the zero- tariff entries in our sample. Albeit representing only a small portion of the sample (approximately 10%), they may be central to the key results given that they represent partners with free trade and hence little variation in tariffs over time. To examine this, we estimate a sub-sample with the zero entries excluded. The results in column 1 indicate that the main results remain to hold in sign, significance, and magnitude, and hence are not driven by the zero entries in the sample.

Second, we add two additional relevant measures (in $t-1$) to the estimated model, to control for exploration efforts, and labour market rigidity. Our main identification assumption is that the timing of giant oil field discoveries is exogenous; however, it may be a manifest of exploration efforts, which are endogenous to the economic and institutional setting. Hence, following Arezki et al. (2017), we address that by controlling for exploration efforts via the number of wildcat drillings. Next, Grossman and Helpman (1994) indicate that labour market rigidity may be a key determinant of tariffs, as it may affect

the interplay between lobbyists and policy makers; hence, we include the previously discussed *LAMRIG* index as a proxy for the extent of rigidity in the labour market. The results in column 2 indicate that the main patterns are robust to the inclusion of these additional controls.

Table 9: Additional robustness tests

Dependent variable: Average tariff	(1) Excluding zeros	(2) Exploration, Labour market rigidity	(3) Onshore discoveries	(4) Offshore discoveries	(5) Non-sequential discoveries	(6) Bilateral controls	(7) Pre-2000	(8) Post-2000	(9) Additional Controls
Discovery	0.6***	0.78***				0.64***	1.16***	0.47***	0.74***
	(0.02)	(0.04)				(0.02)	(0.04)	(0.04)	(0.03)
Production	-0.25***	-0.43***				-0.26***	-0.09***	-0.13***	-0.15***
	(0.03)	(0.03)				(0.03)	(0.03)	(0.03)	(0.03)
Discovery_onshore			0.14***						
			(0.01)						
Production_onshore			-0.42***						
			(0.02)						
Discovery_offshore				0.44***					
				(0.03)					
Production_offshore				-1.43***					
				(0.04)					
Discovery_nonseq					0.16***				
					(0.04)				
Production_nonseq					-0.22***				
					(0.04)				
Importer and exporter fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Product-by-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Product-by-importer, year and exporter fixed effects	No	No	No	No	No	No	No	No	Yes
R-squared, adjusted	0.39	0.47	0.404	0.405	0.404	0.41	0.52	0.38	0.37
Observations	2727188	1677772	2850054	2850054	2850054	2818944	904033	1946021	2323574

Notes: Standard errors are robust, clustered by country pairs and products and appear in parentheses for independent variables. Superscripts *, **, *** correspond to a 10, 5 and 1% level of significance. The complete sample includes country pairs of 155 small open economies, across 96 (2-digit HS codes) products over the period 1988-2012 (pre/post-2000 in Columns 7/8, respectively). In Column 1 the sample is restricted to non-zero values in the dependent variable. The dependent variable is the average, ad-valorem tariff rate. 'Discovery[_onshore/offshore/nonseq]' ('Production[_onshore/offshore/nonseq]') is a dummy variable that indicates whether a discovery of a giant oil or gas field occurred [onshore, offshore, or non-sequentially] within the precedent 4 years (5 to 9 years). All regressions include in addition an intercept, and the following controls (in t-1): importer/exporter real per capita GDP and democracy levels, bilateral distance (great circle), and an indicator for common border. Column 2 includes the number of wildcat drillings and the LAMRIG index in t-1; Column 6 includes the following additional bilateral controls: common language, common coloniser, common currency, common religion, and common legal system. Column 9 includes the country-product-year trade balance and changes in imports in the precedent period. For further information on variables see Appendix A.

Third, we examine the role of the type of giant oil field discoveries. Most discoveries are made offshore, but some are also made onshore. Each type bears its own characteristics, which may affect trade policies. For instance, offshore discoveries are generally larger and may induce international tension due to unclear boundaries of water territories. Hence, in columns 3 and 4 we test sub-samples of onshore and offshore discoveries, respectively. The results indicate that the baseline patterns in changes in tariffs

following a giant discovery are observed in both cases. However, they are stronger, both in the initial increase and later decrease, for offshore discoveries.

Fourth, we take an additional test of the underlying identification assumption, namely that the timing of discoveries is exogenous. While initial discoveries may indeed be exogenous, oil discoveries may be serially correlated. Consequently, subsequent discoveries may be the result of endogenous indicators, such as exploration efforts or investment in supportive infrastructure. To examine whether this potential concern affects the analysis and results, we exclude from the sample all discoveries that were made subsequently to others. Estimating this restricted sub-sample in column 5 we find that the main results still hold both qualitatively and quantitatively under the exclusion of these subsequent discoveries.

Fifth, in our baseline results we controlled for the two main bilateral trade indicators, namely distance and border. We did so to minimise the addition of potentially endogenous measures, which add relatively little explanatory power beyond the two key ones. To test whether this affects the main results, we add additional bilateral controls, namely common language, coloniser, currency, religion, and legal system (all in $t-1$). The results in column 6 indicate that our baseline results are robust to the inclusion of these additional measures.

Sixth, we take a more in depth look at the role of time. The main analysis yields an average effect, while controlling for time effects. To examine whether different patterns arise in different periods, we divide the sample into two sub-samples using the year 2000 as the cut off, being the mid-year of the complete sample. Hence, in column 7 we examine the sub-sample of years that are pre-2000, and in column 8 we examine the balance. The results indicate that the main patterns for changes in tariffs are observed in both sub-samples, though the rise in the extent of protectionism is stronger in the earlier periods.

Last, we test the role of additional tariff determinants. Previous studies highlighted the role of comparative advantage (e.g. Grossman and Helpman (1994), Constinot et al. (2015)), product market power (Nicita et al. (2018)), surges in imports (Lake and Linask (2017)), and import volatility (Lake and Linask (2017)). To examine whether these determinants affect our baseline results, we estimate a variation of the baseline model which includes exporter, year, and importer-by-product fixed effects, in lieu of the baseline fixed effects employed, and in addition include measures of comparative advantage and import surges. The importer-by-product fixed effects control for importer-by-product unobserved time-invariant heterogeneities, including time-invariant product market power and import volatility (proxies examined in Lake and Linask (2017), for instance). Surges in imports are then proxied by the changes in imports in the precedent period, and comparative advantage is proxied by the trade balance, both at the product and country-pair level, matched to the tariffs data as described in sub-section 4.3.[35] The results in column 9 indicate that our baseline results are robust to the inclusion of these controls.

[35] The latter proxy is based on the assertion that a more positive trade balance points at a revealed comparative advantage in the production of the examined product across the specific country-pair.

6. Conclusion

We have provided theoretical foundations and empirical evidence which indicate that oil discoveries represent a key determinant of trade policy formation. More specifically, we have shown that oil discoveries can be a source of demand for protectionism before and after the oil production stage. We have also shown that credit constraints, and the dominance of the tradable sector, matter in tariff policy decisions. Furthermore, our empirical analysis suggests that the protection of the most internationally competitive industries is the main driving force of tariff changes.

We have first set up a political economy model of the Dutch disease in which policymakers, knowing the future windfall of oil revenues, choose the path of tariff rates to maximise the weighted sum of the different population groups' consumption levels. The model predicts that, if the tradable sector is politically dominant, then the oil discovery induces tariff protection. Moreover, if the economy is also credit constrained, this effect is stronger upon discovery and partially reversed when production materialises. The reason behind the more intensive effect during the pre-production stage is the inability to perfectly smooth consumption via judicious debt management.

We have tested these predictions employing bilateral tariff data for 96 products in 155 countries over the period 1988-2012, and worldwide discoveries of giant oil and gas fields that can be considered relatively exogenous. Consistent with the theory, the data have supported that an oil discovery raises tariffs during pre-production years and decreases them in the years to follow yet to a lesser extent. These effects are more significant in capital-scarce economies with a relatively dominant tradable sector. These patterns were shown to be robust to a multitude of tests and quantitatively large.

References

Arezki, R., A.V. Ramey, and L. Sheng (2017). News shocks in open economies: Evidence from giant oil discoveries, *Quarterly Journal of Economics*, 132(1),103-155.

Arezki, R., F. van der Ploeg, and F. Toscanini (2019). The shifting natural wealth of nations: the role of market orientation, *Journal of Development Economics*, 138, 228-245.

Barsky, R.B., S. Basu and K. Lee (2014). Whither news shocks?, NBER Working Paper No. 20666.

Bianchi, J., C. Liu and E.G. Mendoza (2016). Fundamentals news, global liquidity and macroprudential policy, *Journal of International Economics*, 99, S2–S15.

Beaudry, P. and F. Portier (2006). Stock prices, news, and economic fluctuations, *American Economic Review*, 96(4), 1293–1307.

Beaudry, P., and F. Portier (2014). News driven business cycles: insights and challenges, *Journal of Economic Literature*, 52 (2014), 993–1074.

Besley, T., and R. Burgess (2002). The political economy of government responsiveness: theory and evidence from India, *Quarterly Journal of Economics*, 117(4), 1415–1451.

Campus, F.N. and J.B. Nugent (2012). The dynamics of the regulation of labor in developing and developed countries since 1960, IZA Working Paper No. 6881.

Caselli F. and G. Michaels (2013). Do oil windfalls improve living standards? Evidence from Brazil, *American Economic Journal: Applied Economics*, 5(1), 208-38.

Collier, P. and A.J. Venables (2011). Illusory revenues: Import tariffs in resource-rich and aid-rich economies, *Journal of Development Economics*, 94, 2, 202-206.

Corden, A. and J.P. Neary (1982). Booming sector and de-industrialisation in a small open economy. *Economic Journal*, 92, 825-848.

Costinot, A., D. Donaldson, J. Vogel and I. Werning (2015). Comparative advantage and optimal trade policy, *Quarterly Journal of Economics*, 130(2), 659-702.

Cotet, A.M. and K.K. Tsui (2013). Oil and conflict: What does the cross country evidence really show?, *American Economic Journal: Macroeconomics*, 5(1), 49-80.

Cust, J. and T. Harding (2019). Institutions and the location of oil exploration, *Journal of the European Economic Association*, forthcoming.

Edwards, S. (1997). Trade policy, growth, and income distribution, *American Economic Review*, Papers and Proceedings, 87, 2, 205-210.

Fajgelbaum, D.P., K.P. Goldberg, J.P. Kennedy and K.A. Khandelwal (2019). The return to protectionism, NBER Working Paper No. 25638.

Furceri, D., S.A. Hannan, J.D. Ostry and A.K. Rose (2018). Macroeconomic consequences of tariffs, NBER Working Paper No. 25402.

Gambetti, L., D. Korobilis, J.D. Tsoukalas and F. Zanetti (2017). The effect of news shocks and monetary policy, Discussion Papers 1730, Centre for Macroeconomics.

Gawande, K. and P. Krishna (2003). The political economy of trade policy: Empirical approaches, *Handbook of International Trade*, James Harrigan, ed., Basil Blackwell.

Harding, T., R. Stefanski and G. Toews (2019). Boom goes the price: Giant resource discoveries and real exchange rate appreciation, *Economic Journal*, to appear.

Hill, H. (1997). *Indonesia's Industrial Transformation*. Singapore: Institute of Southeast Asian Studies.

Grossman, G.M. and E. Helpman (1994). Protection for sale, *American Economic Review*, 84, 4, 833-850.

Horn, M.K. (2011). *Giant Fields Data Set*, revision16: AAPG-GIS Open file. Available at: http://archives.datapages.com/.

Jaimovich, N., and S. Rebelo (2009). Can news about the future drive the business cycle?, *American Economic Review*, 99, pp. 1097–1118.

Keynes, J.M. (1936). *The General Theory of Employment, Interest and Money*. London: Macmillan.

Kuncoro, A. (2018). Trends in the manufacturing sector under the Jokowi presidency: legacies of past Administrations, *Journal of Southeast Asian Economies*, 35(3), 402-24.

Lake, J., and M. Linask (2017). Could tariffs be pro-cyclical? *Journal of International Economics*, 103, 124-146.

Lei, Y., and G. Michaels (2014). Do giant oil field discoveries fuel internal armed conflicts? *Journal of Development Economics*, 110,139-157.

Leong, W. (2009). *Malaysia Catches the Dutch Disease*. Centre for Policy Initiatives, http://www.cpiasia.net/v3/index.php/219-contributors-sp-642/contributors/1749-malaysia-catches-the-dutch-disease.

Long, N.V. and N. Vousden (1991). Protectionist responses and declining industries, *Journal of International Economics*, 30, 1-2, 87-103.

Lorenzoni. G. (2010). Optimal monetary policy with uncertain fundamentals and dispersed information. *Review of Economic Studies*, 77:305–38.

Ludema, R.D., and A.M. Mayda (2013). Do terms-of-trade effects matter for trade agreements? Theory and evidence from WTO countries. *Quarterly Journal of Economics*, 128(4), 1837-1893.

Ludema, R.D., A.M. Mayda, and P. Mishra (2010). Protection for free? The political economy of U.S. tariff suspensions, Working Paper WP/10/211. Washington, D.C.: IMF.

Marks, S.V. (2017). Non-tariff trade regulations in Indonesia: Nominal and effective rates of protection, *Bulletin of Indonesian Economic Studies*, 53(3), 333-57.

McLaren, J. (2016). The political economy of commercial policy. In K. Bagwell and R.W. Staiger (Eds.), *Handbook of Commercial Policy*, volume 1, part A, pp. 109-159. Amsterdam: Elsevier.

Mehlum, H., K. Moene and R. Torvik (2006). Institutions and the Resource Curse, *Economic Journal*, 116, 508, 1-20.

Narayanan, S. 2007. The challenges of raising revenues and restructuring subsidies in Malaysia, *Kajian Malaysia*, 25(2), 1-28.

Nehru, V. (2012). Indonesian manufacturing and the middle-income trap, East Asia Forum, 7.

Neary, J.P. (1988). Determinants of the equilibrium real exchange rate, *American Economic Review*, 78, 1, 210-215.

Nicita, A., M. Olarreaga, and P. Silva (2018). Cooperation in WTO's Tariff Waters? *Journal of Political Economy*, 126(3), 1302-1338.

Nickell, S. (1981). Biases in dynamic models with fixed effects, *Econometrica*, 49, 1417-1426.

Perez-Sebastian, F. and O. Raveh (2016). Natural resources, decentralization, and risk sharing: can resource booms unify nations?, *Journal of Development Economics*, 121, 38-55.

Perez-Sebastian, F. and O. Raveh (2019). Federal tax policies, congressional voting, and natural resources, *Canadian Journal of Economics*, 52(3), 1112-1164.

Pigou, A.C. (1927. *Industrial Fluctuations*. London: Macmillan, 1927).

Ploeg, F. van der (2011). Natural resources: curse or blessing?, *Journal of Economic Literature*, 49(2), 366-420.

Ploeg, F. van der and A.J. Venables (2011). Harnessing windfall revenues: optimal policies for resource-rich developing economies, *Economic Journal*, 121, 551, 1-30.

Ploeg, F. van der and A.J. Venables (2013). Absorbing a windfall of foreign exchange, *Journal of Development Economics*, 103, 229-243.

Pritchett, L. (2000). The tyranny of concepts: CUDIE (cumulated, depreciated, investment Effort) is not capital, *Journal of Economic Growth*, 5(4), 361–384.

Saint-Paul, G. (2004). Why are European countries diverging in their unemployment experience?, *Journal of Economic Perspectives*, 18(4), 49-68.

Smith, A. (1776). *An Inquiry into the Nature and Causes of the Wealth of Nations*. Oxford: Clarendon Press.

Tornell, A. and P.R. Lane (1999). The Voracity Effect, *American Economic Review*, 89(1), 22-46.

Trump, D. (2017). *The Inaugural Address*, The White House, https://www.whitehouse.gov/Inaugural-address.

Widodo, T. (2008). The structure of protection in Indonesian manufacturing sector, *ASEAN Economic Bulletin*, 25(2), 161-178.

Wihardja, M.M. (2016). The effect of the commodity boom on Indonesia's macroeconomic fundamentals and industrial development, *International Organizations Research Journal*, 11(1), 39-54.

WTO (2004). Trade Policy Review – Malaysia, World Trade organization WT/TPR/S/156, Geneva.

Yean, T.S. and L.W. Heng (2011). Industrial deepening in Malaysia: Policy lessons for developing Nations, *Asian Development Review*, 28(2), 88-109.

Appendix A: Data

We use an annual-based panel of country-pairs that covers 155 countries, across 96 (2-digit HS level) products, over the period 1988-2012. Real terms are in 2009 prices. Descriptive statistics for the variables in the complete sample appear in Table 1. Descriptive statistics for the variables in the sample of countries that had at least one discovery of an oil or gas field during the sample period, versus those that had none, appear in Table A1.

Table A1-A: Summary statistics of the key variables of economies with a discovery

	Economies with a discovery			
	Mean	Std. Dev.	Min.	Max.
Ad valorem tariff, simple average (2-digit HS level, bilateral, percentage points)	12.87	12.59	0	2406
Ad valorem tariff, weighted average (2-digit HS level, bilateral, percentage points)	13.12	13.52	0	2406
Giant oil field discovery (importing country)	0.201	0.401	0	1
NPV of giant oil discoveries in percentage of GDP, realistic production profile (percentage points)	5.63	52.27	0	1130.072
NPV of giant oil discoveries in percentage of GDP, constant production profile (percentage points)	4.24	27.0	0	436.643
Democracy level (importing country)	7.15	2.21	1	10
GDP per capita (real USD)	7341.99	11326.05	174.51	62138.66
Imports per capita (2-digit HS level, bilateral, real USD)	0.18	3.54	0	781.07
Tradables' bargaining position	0.3	0.15	0.03	0.696
Credit constrained	0.78	0.41	0	1
Saving per capita (real USD, in thousands)	1.99	4.44	-0.62	37.26
Average tariff rate (importing country, percentage points)	12.93	7.41	0	54.73
Wildcat drillings (importing country)	18.76	26.96	0	147

Notes: For detailed description of variables see Appendix.

A.1 List of countries in the sample

Afghanistan, Albania, Algeria, American Samoa, Andorra, Angola, Antigua and Barbuda, Argentina, Aruba, Australia, Austria, Bahamas, Bahrain, Bangladesh, Barbados, Belize, Benin, Bermuda, Bhutan, Bolivia, Brazil, Brunei, Bulgaria, Burkina Faso, Burundi, Cambodia, Cameroon, Canada, Cape Verde, Cayman Islands, Central African Republic, Chad, Chile, China, Colombia, Comoros, Congo, Costa Rica, Cote D'Ivoire, Cuba, Cyprus, Djibouti, Dominican Republic, Ecuador, Egypt, El Salvador, Equatorial Guinea, Fiji, French Polynesia, Gabon, Gambia, Ghana, Gibraltar, Greenland, Grenada, Guam, Guatemala, Guinea, Guinea-Bissau, Guyana, Haiti, Honduras, Iceland, Indonesia, Iran, Iraq, Israel, Jamaica, Japan, Jordan, Kenya, Kiribati, Laos, Lebanon, Liberia, Libya, Madagascar, Malawi, Malaysia, Maldives, Mali, Malta, Mauritania, Mauritius, Mexico, Mongolia, Morocco, Mozambique, Myanmar, Nauru, Nepal, Netherlands, New Caledonia, New Zealand, Nicaragua, Niger, Nigeria,

Oman, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Qatar, Rwanda, Saint Kitts and Nevis, Saint Lucia, Saint Vincent, Samoa, Sao Tome and Principe, Saudi Arabia, Senegal, Seychelles, Sierra Leone, Singapore, Solomon Islands, South Korea, Somalia, Sri Lanka, Sudan, Suriname, Syria, Tanzania, Thailand, Togo, Tonga, Trinidad and Tobago, Tunisia, Turkey, Turks and Caicos Islands, Tuvalu, Uganda, United Arab Emirates, Uruguay, Vanuatu, Venezuela, Vietnam, Zaire, Zambia, Zimbabwe.

Table A1-B: Summary statistics of the key variables of economies without a discovery

	Economies without a discovery			
	Mean	Std. Dev.	Min.	Max.
Ad valorem tariff, simple average (2-digit HS level, bilateral, percentage points)	11.23	8.67	0	614.2662
Ad valorem tariff, weighted average (2-digit HS level, bilateral, percentage points)	10.97	8.68	0	614.2662
Giant oil field discovery (importing country)	0	0	0	0
NPV of giant oil discoveries in percentage of GDP, realistic production profile (percentage points)	0	0	0	0
NPV of giant oil discoveries in percentage of GDP, constant production profile (percentage points)	0	0	0	0
Democracy level (importing country)	7.87	2.12	1	10
GDP per capita (real USD)	10166.52	12979.63	140.82	82192.96
Imports per capita (2-digit HS level, bilateral, real USD)	0.49	23.58	0	15159.12
Tradables' bargaining position	0.3	0.12	0.004	0.584
Credit constrained	0.56	0.49	0	1
Saving per capita (real USD, in thousands)	2.45	3.67	-2.46	24.303
Average tariff rate (importing country, percentage points)	11.23	6.71	0	56.73
Wildcat drillings (importing country)	10.43	48.05	0	545

Notes: For detailed description of variables see Appendix.

A.2 List of countries that had at least one discovery of an oil or gas field during the sample period

Algeria, Angola, Argentina, Australia, Bolivia, Brazil, China, Colombia, Egypt, Equatorial Guinea, Ghana, Indonesia, Iran, Israel, Libya, Malaysia, Mozambique, Myanmar, Nigeria, Oman, Pakistan, Peru, Philippines, Qatar, Saudi Arabia, Thailand, Trinidad and Tobago, Venezuela, Vietnam.

A.3 Variable definitions

Ad-valorem tariff: The bilateral ad-valorem of 2-digit HS level products, calculated either as a simple average, or weighted average (using import-shares as weights). Source: The World Bank's WITS-TRAINS database.

Giant oil or gas field discovery: A binary variable that captures giant oil or gas field discoveries in the importing country. A giant oil or gas field is one for which the estimate of ultimately recoverable oil is at least 500 million barrels of oil or gas equivalent. It may be onshore or offshore. Source: Horn (2011).

NPV of giant oil discoveries: The net present value of giant oil field discoveries, computed by Arezki et al. (2017), under either realistic or constant production profile.

Democracy level: A country's level of democracy measured via the Polity IV index. Source: Polity IV Project, Center for Systemic Peace.

GDP per capita: Real GDP divided by population. Source: The World Bank.

Imports per capita: Real partner-specific imports at the 2-digit HS level divided by population. Source: UN-Comtrade database.

Tradables' bargaining position: The interaction of the country's GDP share of the manufacturing sector (Source: The World Bank) and the level of its *LAMRIG* index that captures the rigidity of employment protection legislation (Source: Campus and Nugent (2012)).

Credit constrained: A binary variable that takes the value 1 if the country received financial assistance from the World Bank or other similar international organisations during the sample period. Source: The World Bank.

Saving per capita: Real saving divided by population. Source: The World Bank.

Wildcat drillings: The number of wildcat drillings in a country. Source: Arezki et al. (2017).

Bilateral controls: Indicators for having bilateral common language, common coloniser, common currency, common religion, and common legal system. Source: The CEPII database.

Appendix B: Sectoral division

Group name: 2-digit HS categories included

Animal products: 01-05 ; Foodstuffs: 06-24 ; Mineral products: 25-27 ; Chemicals: 28-38 ; Plastics: 39-40 ; Raw hides and leather: 41-43 ; Wood products: 44-49 ; Textiles: 50-63 ; Footwear: 64-67 ; Stone and glass: 68-71 ; Metals: 72-83 ; Machinery: 84-85 ; Transportation: 86-89 ; Optical apparatus: 90-97.

Appendix C: Functional forms

We use Cobb-Douglas production functions, $l^N = k^N\left((1-\alpha)p/w\right)^{1/\alpha}$, $l^T = k^T\left((1-\alpha)(1+\tau)/w\right)^{1/\alpha}$, $y(p,\tau) = \left(p^{\frac{1}{\alpha}}k^N + (1+\tau)^{\frac{1}{\alpha}}k^T\right)^{\alpha}$, $w(p,\tau) = (1-\alpha)y$ and $y^N = y_p = k^N\left[k^N + \left((1+\tau)/p\right)^{\frac{1}{\alpha}}k^T\right]^{\alpha-1}$.

Since $y_{pp} = \frac{1-\alpha}{\alpha}\frac{y_p}{p}\frac{\left((1+\tau)/p\right)^{\frac{1}{\alpha}}k^T}{k^N + \left((1+\tau)/p\right)^{\frac{1}{\alpha}}k^T}$, we have $\varepsilon_N^S = \frac{1-\alpha}{\alpha}\frac{\left((1+\tau)/p\right)^{\frac{1}{\alpha}}k^T}{k^N + \left((1+\tau)/p\right)^{\frac{1}{\alpha}}k^T} > 0$. Tradables supply $y^T(p) = y_\tau = k^T\left[\left(p/(1+\tau)\right)^{\frac{1}{\alpha}}k^N + k^T\right]^{\alpha-1}$ rises in the tariff and falls in the price of non-tradables. With Cobb-Douglas utility $\varepsilon^N = 1-\phi^N > 0$ and $\varepsilon^{NC} = \phi^T > 0$.[36]

[36] With CES utility all goods are Hicksian substitutes too.

Appendix D: Effect of oil discoveries on tariff revenues

The main analysis focused on the impact of oil discoveries on tariffs, showing that in the pre-production phase they increased primarily in negligibly-imported goods. The theoretical analysis rationalised these increases by considering political distortions and preferences for consumption smoothing. To test the consistency of the results with the latter, we next examine the impact of oil discoveries on tariff revenues. We construct the latter at the product and country-pair level by interacting the level of ad-valorem tariff with the corresponding value of imports (matched as described in sub-section 4.3).

We estimate a version of equation (13) in which the dependent variable is the constructed tariff revenues. We follow the stricter, dynamic specification (as per column 4 of Table 3). The results appear in Table A2. In columns 1 and 2 we include *Prod* and *Disc* separately; column 3 includes both. The estimated coefficients indicate that tariffs are changed in products that are located on the left side of the Laffer Curve. Specifically, during the pre-production phase, while tariffs increase, tariff revenues rise, whereas during the post-production phase, when tariffs decrease, tariff revenues fall. These observed patterns lend further support to the proposed theoretical mechanism.

Table A2: Tariff revenues

Dependent variable: Tariff revenues	(1)	(2)	(3)
Discovery	0.002***		0.002***
	(0.0004)		(0.0004)
Production		-0.006***	-0.006***
		(0.0004)	(0.0004)
Tariff revenues *(t-1)*	0.91***	0.91***	0.91***
	(0.002)	(0.002)	(0.002)
Importer and exporter fixed effects	Yes	Yes	Yes
Product-by-year fixed effects	Yes	Yes	Yes
R-squared, adjusted	0.78	0.81	0.81
Observations	2847849	2847849	2847849

Notes: Standard errors are robust, clustered by country pairs and products and appear in parentheses for independent variables. Superscripts *, **, *** correspond to a 10, 5 and 1% level of significance. Sample includes country pairs of 155 small open economies, across 96 (2-digit HS codes) products, over the period 1988-2012. The dependent variable is tariff revenues. 'Discovery' ('Production') is a dummy variable that indicates whether a discovery of a giant oil or gas field occurred within the precedent 4 years (5 to 9 years). All regressions include in addition an intercept, and the following controls (in t-1): importer/exporter real per capita GDP and democracy levels, bilateral distance (great circle), and an indicator for common border. For further information on variables see Appendix A.