

The trade consequences of pricey oil

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Abstract

This paper examines the trade and trade-induced welfare effects of oil prices. Using a gravity model of trade we find that the distance elasticity of trade significantly increases with the oil price. This suggests that high oil prices make trade less global, as they affect longer shipping routes more. We estimate that an increase in the oil price from 100\$ to 200\$ (in 2014 US\$) would have similar trade effects as an import tariff around 17% for two countries 10,000 km away. This is akin to a 55% increase in shipping distance. This trade reduction would lower welfare by 0.03% in the average non-oil-exporting country.

JEL classification: F14, Q43

Keywords: oil prices, gravity, trade costs

1 Introduction

The 2000s saw a drastic increase in the oil price, from around 30\$ a barrel in 2001 to above \$100 in 2008, an unprecedented high (see Figure 1). The oil price plunged as the Global Crisis hit the world economy in late 2008, but then gradually recovered to its pre-crisis level until June 2014 when it was cut roughly by half. The consequences of such oil price fluctuations on the world economy are many yet hard to pin down (see Barsky

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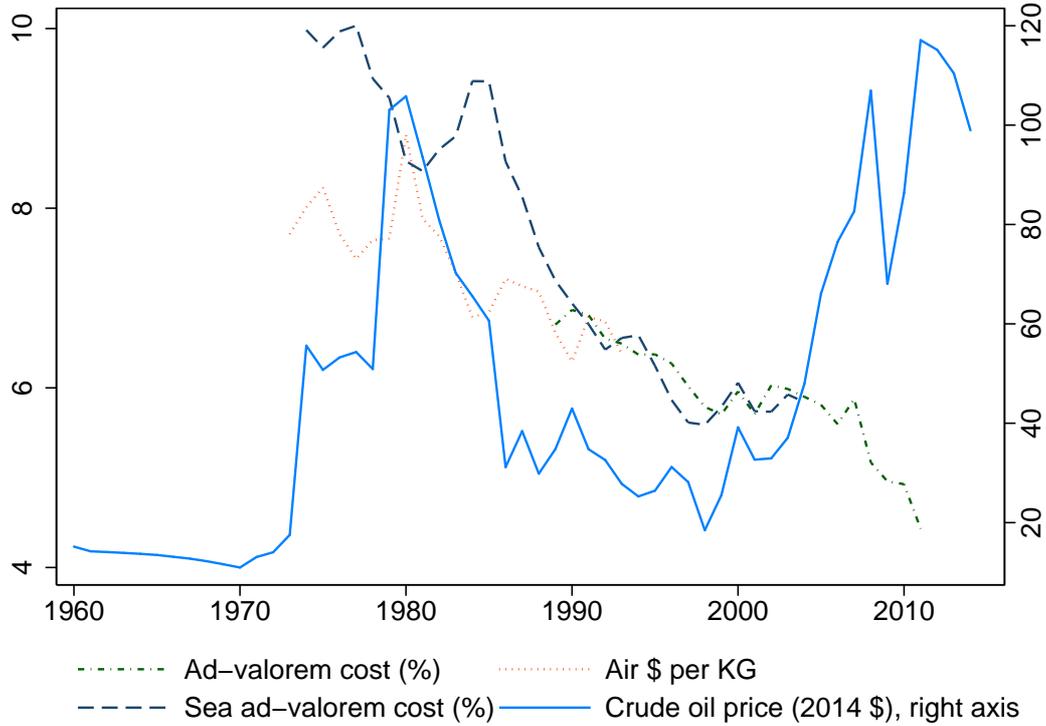
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and Kilian (2004)). In this paper we aim to identify one such effect, namely the trade consequence of varying shipping costs due to varying oil prices. When the oil price reached its peak in 2008, Paul Krugman argued that “higher fuel prices are putting the brakes on globalization: if it costs more to ship stuff, there will be less shipping” (Krugman, 2008). The increase in trade costs due to pricey oil may in turn reduce real income due to fewer gains from trade. As Chinn (2008) and Bergin and Glick (2007) explained, oil prices feed (roughly) into transportation costs. As oil prices and thus transport costs rise, goods markets become more insulated. More goods become non-traded, leading to higher home bias and thus higher consumption prices. Moreover, recent anecdotal evidence suggest high oil prices are driving an insourcing boom in the US (Fishman, 2012; Rochter, 2008) and the return of manufacturing to Mexico from China (Economist, 2012). Conversely, the recent price drop could be a boon for globalization. The trade consequences of oil prices should thus be examined carefully.

The aim of this paper is to estimate the effect of oil prices on trade via the change in shipping costs. We face two main challenges. The first is that oil prices influence the economy through a multitude of channels, from consumer demand through the pump price to banks’ transactions via inflation forecasts. Hence we need to be careful in isolating the reduction of trade due solely to increases in shipping costs. A second hurdle is to identify the change in shipping costs which is due to oil prices. Shipping costs depend on many factors other than oil, such as port fees and insurance, and are endogenous to trade (Asturias and Petty, 2012; Kleinert and Spies, 2011). More trade means more liners and more ports which in turn mean lower shipping costs, and this may explain why the latter have been declining continuously in ad-valorem terms from 6.75% in 1990 to below 4.5% in 2011 while the oil price has been rising (see Figure 1). While concurring spikes in shipping costs and oil prices in 1990, 2000, and during the recent crisis suggest oil prices may affect shipping costs, the effect of oil prices on shipping costs remains hard to identify. Moreover, oil prices themselves may be influenced by countries’ demand for foreign goods and thus may be endogenous to trade. Additionally, a third challenge is that bilateral shipping cost data are not available for many countries, and when they are it is only for the last 20 years or so.

The gravity model of trade (Anderson and van Wincoop, 2003) and two identifying assumptions allow us to deal with these hurdles and identify the shipping-cost effect of oil prices on trade. The gravity equation models trade between two countries as a function of the distance between them, where distance is an exogenous measure of shipping costs.

Figure 1: Shipping costs and oil prices



Note: The crude oil price is in 2014 US dollars and from the BP review. Ad-valorem costs are measured as the average US import cif-to-fob ratio, i.e. the ratio of US import values including freight and insurance (cif) to that free on board (fob). This is one of the most precise available measure of shipping costs and is computable using USITC data. Sea ad-valorem cost is taken from Hummels (2007) and is defined as expenditure/import value based on US Imports of Merchandise from the US Census Bureau. It is adjusted to changes in the mix of trade partners and products. Air \$ per KG is the average air cargo freight rate (in real dollars per kilogram). It is also taken from Hummels (2007) and is originally from the International Civil Aviation Organization.

What’s more, the model allows us to control for any country-year shock with fixed effects, thus identifying the geography of trade patterns due solely to bilateral trade costs. To include oil prices in the model, we need to make one identifying assumption, namely that oil prices affect long-distance trade more than short-distance trade. This can be justified by shipping costs including both fixed and variable costs and oil prices affecting only the latter, hence accounting for a large share of trade costs for long distances (see the model by Mirza and Zitouna (2010)). This assumption is further justified by the same authors who provide empirical evidence that the oil-price elasticity of freight rates is indeed higher for countries further away. We can thus model trade between two countries as a function of the interaction of distance and oil prices. One hurdle remains as oil prices may increase with an increase in demand for long-distance trade, and this renders the interaction of the oil price and distance endogenous to trade. We thus instrument oil prices with the yearly number of conflicts in OPEC countries, which captures supply-side oil-price shocks. This allows us to obtain an exogenous oil-price-driven change in bilateral trade costs and identify the decrease in trade between any two countries due to oil prices.¹

We estimate gravity equations using port-to-port shipping distance data from Searoutefinder and bilateral trade data for the whole non-landlocked world for the period 1962–2014. We find a significant interaction of distance with the oil price in both OLS and IV regressions, and this result is robust to including importer-year, exporter-year and country-pair fixed effects. In years of high oil prices, distance matters significantly more in reducing trade. In other words, trade is less global in years of high oil prices. This pattern also holds when we estimate the distance coefficients by year and regress them on oil prices and when we include all zero bilateral flows and control for potential heteroscedasticity problems using the Poisson pseudo-maximum-likelihood estimator suggested by Silva and Tenreyro (2006).

To quantify our results we estimate the tariff equivalent of an oil increase from 100\$ to 200\$ using trade elasticity estimates from the literature (Eaton and Kortum, 2012). We find that this price hike could have the same effect on trade as imposing a tariff of around 17%, depending on the distance between countries. This is also akin to increasing distances by around 55%. We also plug the change in trade costs driven by the change in distance-elasticity into the formula proposed by Arkolakis et al. (2012) to calculate the

¹Our gravity model also allows us to include country-pair fixed effects, leaving only the interaction of distance and oil prices as an explaining variable. This method is akin to Rajan and Zingales’ (1998) identification of the effect of financial development on growth via the interaction of sectoral finance-dependance with country-level financial-market developments.

welfare loss due to lower gains from trade. We find that in the average non-oil-exporting country, welfare may be 0.3% lower than it would have been if oil prices had remained at 100\$. We find that the countries most open to international trade would lose most.

The remainder of the paper is organized as follows. In the next section we review the literature on oil prices on trade. The third and fourth sections describe our empirical strategy and results. Section 5 presents the income loss from high oil prices and the last one concludes.

2 Literature review

Strangely enough, relatively little research in the field of international trade focuses on the impact of oil prices on trade. In a comprehensive survey, Hummels (2007) summarizes research on transport costs and trade. He gives illustrative evidence that oil-price shocks may be behind charter-trip price spikes and that it was only when crude oil prices began to drop in the mid 1980s that ocean shipping costs really began to fall. He cites one study by Sletmo and Williams (1981) which reports that liner operating costs rose by as much as 18% per annum in the 1970s as a result of the oil-price shocks. Levinson (2006) suggests that fuel is 40 to 63% of operating costs depending on ship size. Beverelli (2010) reviewed the literature on freight costs, which is rather more abundant, and suggests that oil fuel is used for 95% of world transport, and that the oil-price elasticity of freight rates is between 0.19 and 0.36 but higher since 2004 as prices are rising and volatile.

While there is ample evidence that oil prices affect freight rates, there appears to be little research done about how oil prices affect trade. An interesting paper that identifies the impact of shipping costs on trade is Feyrer (2009) who estimates the decline in trade due to the closing of the Suez canal during the 1967 war. Yet this exogenous change in shipping costs is due to a change in distance, not oil costs. A study by Brun et al. (2005) adds oil prices to the gravity model yet the goal of the latter is to explain the distance puzzle, i.e. the rising effect of distance on world trade, and hence little effort is made to identify the oil-price effect. Indeed, it does not control for country-year shocks. What they find however is that oil prices solve much of the distance puzzle, i.e. the distance elasticity may have increased due to increased oil prices.² If this is indeed the case, high oil prices would imply de-globalization and a re-bundling of production and consumption, and low

²Assche et al. (2011) runs a similar regression for China for the years 1988–2008 and find that high oil prices do affect the sensitivity of China’s export to distance.

prices would be a boon for global integration. A report by the investment bank CIBC (2008) suggested that the explosion in global transport costs in the 2000s had effectively offset all the trade liberalization efforts of the last three decades. Yet the methodology is unclear and the results hard to verify. We aim to investigate further in this paper.

Mirza and Zitouna (2010), in a recent convincing paper, examine the impact of oil prices on the geography of US imports. They model freight costs as a function of both fixed and variable costs with oil prices and distance affecting only variable costs. Oil thus accounts for a larger share of freight costs for countries further away. They then estimate the oil-price elasticity of freight costs and find it to be an increasing function in distance. They then estimate the freight-cost elasticity of trade separately (and via 3SLS) using a gravity-like trade equation. By combining these two elasticities they find that an oil-price shock that results in a doubling of oil prices would increase the relative share of US ‘neighbors’ by around 0.8% and decrease faraway partners’ shares by around 0.047%.

Our work is a reduced-form version of the Mirza and Zitouna regression, abstracting from measures of shipping costs and assuming, as they do, that the interaction of oil and distance affects trade only via shipping costs. This allows us to use trade data for the whole non-landlocked world since 1962 and estimate a state-of-the-art gravity equation including importer-year and exporter-year fixed effects. Furthermore, we go deeper in interpreting the regression coefficients by estimating tariff equivalents and real-income losses.

Two other existing studies are close to our strategy. The first is a paper by Storeygard (2012) which investigates the role of intercity transport costs in determining the income of sub-Saharan African cities. While he does not look at trade flows, he shows that the income of cities that are further away from major ports are more deeply affected by oil-price increases than cities near major ports. His identification is hence also based on the interaction of geographic distance (here the distance from cities to major ports rather than between countries) and oil prices, yet his left-hand side variable is light-intensity, a proxy for income, rather than bilateral trade. The second study is the paper by Bergin and Glick (2007) which looks at the causes of bilateral price-dispersion. It shows that price dispersion between 120 cities worldwide followed a U-shaped pattern that coincides well with oil-price fluctuations and hence argues, also using the interaction of distance and oil prices, that rising transportation costs are driving international price dispersion.

3 Empirical model

To identify the effect of oil prices on trade we start with the gravity model of trade (Anderson and van Wincoop, 2003):

$$m_{ijt} = \frac{y_{it}y_{jt}}{y_{wt}} \left(\frac{t_{ijt}}{P_{it}\Pi_{jt}} \right)^\epsilon \quad (1)$$

where m_{ijt} are non-oil imports of country i from country j in year t , y_i is total income in importing country i , y_j is total income in exporting country j , y_w is total world income, t_{ij} are trade costs between country i and country j , ϵ is the trade cost elasticity of bilateral imports, and P_i and Π_j are the multilateral resistance terms in the importing (inward) and exporting (outward) country, respectively.³

We follow the literature and model bilateral trade costs (t_{ij}) as a function of distance as well as other trade frictions, and add the oil price:

$$t_{ijt} = D_{ij}^{\alpha_D} O_t^{\alpha_O \ln(D_{ij})} e^{B_{ij}\alpha_B} e^{C_{ij}\alpha_C} e^{CL_{ij}\alpha_{CL}} \quad (2)$$

where the α s are parameters and D_{ij} is the distance between countries i and j , O_t is the oil price in year t , B_{ij} is a dummy variable taking the value 1 when countries i and j share a border, C_{ij} is a dummy variable taking the value 1 when countries i and j share a colonial link, and CL_{ij} is a dummy variable taking the value 1 when countries i and j share a common language.

We then substitute (2) into (1) and take logs on both sides to obtain:

$$\begin{aligned} \ln(m_{ijt}) = & \ln(y_{it}) + \ln(y_{jt}) - \ln(y_{wt}) + \beta_D \ln(D_{ij}) + \beta_O \ln(D_{ij}) \ln(O_t) \\ & + \beta_B B_{ij} + \beta_C C_{ij} + \beta_{CL} CL_{ij} - \epsilon \ln(P_{it}) - \epsilon \ln(\Pi_{jt}) \end{aligned} \quad (3)$$

where all β s are parameters to be estimated and $\beta_k = \epsilon \alpha_k$, where k is the subscript indicating the different trade cost variables. We proceed as in much of the empirical literature and control for the multilateral resistance terms (and y_{it} and y_{jt}) including importer-year (it) and exporter-year (jt) fixed effects. The equation to be estimated becomes:

³The expressions for the inward and outward multilateral resistance terms are $P_i = \left[\sum_j (t_{ij}/\Pi_j)^\epsilon \frac{y_j}{y_w} \right]^{1/\epsilon}$ and $\Pi_j = \left[\sum_i (t_{ij}/P_i)^\epsilon \frac{y_i}{y_w} \right]^{1/\epsilon}$.

$$\begin{aligned}\ln(m_{ijt}) = & \alpha_{it} + \sigma_{jt} + \beta_D \ln(D_{ij}) + \beta_O \ln(D_{ij}) \ln(O_t) \\ & + \beta_B B_{ij} + \beta_C C_{ij} + \beta_{CL} CL_{ij}\end{aligned}\tag{4}$$

where α_{it} and σ_{jt} are importer-year and exporter-year fixed effects. In a more demanding version of the model, we also include country-pair fixed effects, θ_{ij} , and hence only the interaction of distance with the oil price remains on the right-hand side:

$$\ln(m_{ijt}) = \alpha_{it} + \sigma_{jt} + \theta_{ij} + \beta_O \ln(D_{ij}) \ln(O_t)$$

If a demand for long-distance trade increases oil prices, our coefficient β_O may be downward biased, as a the distance elasticity would move with oil prices, not against. To correct for this possible bias, we instrument the oil-price-distance interaction with the interaction of distance with the yearly number of armed conflicts, both internal and external, taking place in OPEC countries. These numbers, taken from the UCDP/PRIO Armed Conflict Dataset, capture oil supply shocks and thus variation in the oil price not driven by world demand for foreign goods. As Kilian (2008) explains, the main supply-side oil shocks episodes followed the 1973/74 Arab-Israeli conflict, the Iranian Revolution in late 1978, the outbreak of the Iran-Iraq War in late 1980, the Persian Gulf War of 1990/91, and the Venezuelan crisis and Iraq War of 2002/03.

For our gravity regressions we use annual bilateral trade data for the whole non-landlocked world covering 1962–2014 from UN Comtrade, real oil price data from the BP Review, and shipping distances from Searoutefinder, an online tool for measuring shipping distances between ports. We use the mean port-to-port distance in km for each country pair. Other controls are from CEPII. Descriptive statistics are in Table 1.

4 Results

Results are in Table 3. We find a negative and significant coefficient of -0.165 on the interaction of distance and oil prices in the 2-way fixed effect (importer-year and exporter-year fixed effects) OLS model (column 2). This suggests that when oil prices are lower, trade is more global. Results in column 6, which include country-pair fixed effects on top

Table 1: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Oil price (2014 dollars)	383,576	50.72	31.86	10.97	117.09
ln(1+non-oil imports)	383,576	6.43	4.75	0	19.96
ln(Shipping distance)	383,576	9.02	0.71	4.83	10.03
Border	383,576	0.02	0.13	0	1
Language	383,576	0.16	0.36	0	1
Colony	383,576	0.02	0.15	0	1
Legal	383,576	0.36	0.48	0	1
Currency	383,576	0.01	0.11	0	1
FTA	383,576	0.14	0.35	0	1
OPEC conflicts	334,009	4.17	1.41	1	7

of importer-year and exporter-year fixed effects, confirm the result, albeit reducing the interaction coefficient to -0.106^4 . The left panel of Figure 2 describes the results of the second column of Table 3. When the price of oil is at \$20 a barrel, the distance elasticity of trade is at -1.25 . When the oil price increases to \$100, the distance elasticity increases to -1.55 . In other words, low oil prices make the world smaller.

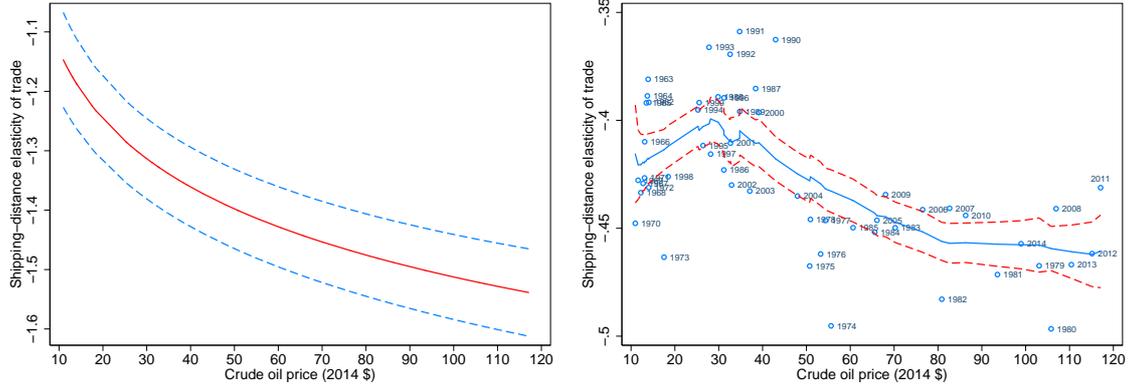
As a robustness check, we estimate the distance elasticity by year (using a Poisson Pseudo Maximum Likelihood model ⁵) and plot the obtained coefficient against the average oil price in the corresponding year in the right panel of Figure 2. While these results confirm that high oil prices may put globalization in reverse, they also confirm the Brun et al. (2005) explanation for the distance puzzle, i.e. the continuing importance of distance in explaining trade patterns. Our results are also robust to excluding oil-exporting countries (not shown).

Table 3 also reports the results of our instrumental-variable estimations. The first-stage results in columns 1 and 5 confirm that the interaction of distance and oil conflicts is a valid instrument for the interaction of distance and oil prices. The coefficient on the instrument is 0.523 in the 2-way fixed effect model and 0.501 in the 3-way fixed effect model and is significant at the 99% level in both models. The second stage results are in columns 3 and 7. The IV coefficients on the interaction of distance and oil prices are -0.271

⁴Both the 2-way and 3-way fixed effect models are estimated using the `reghdfe` Stata command. Only the results without county-pair fixed effects allow for estimates of the level of the distance elasticity, on top of its slope across oil prices. The -0.165 coefficient on the interaction yields distance elasticities between -1.1 and -1.6 . The -0.106 coefficient is more precisely identified due to the inclusion of country-pair fixed effects and is closer to what was found for China's exports by Assche et al. (2011) (-0.043).

⁵The Poisson pseudo-maximum-likelihood estimator was suggested by Silva and Tenreyro (2006) to include all zero trade flows and correct for heteroscedasticity problems.

Figure 2: Low oil prices reduce the distance elasticity of trade

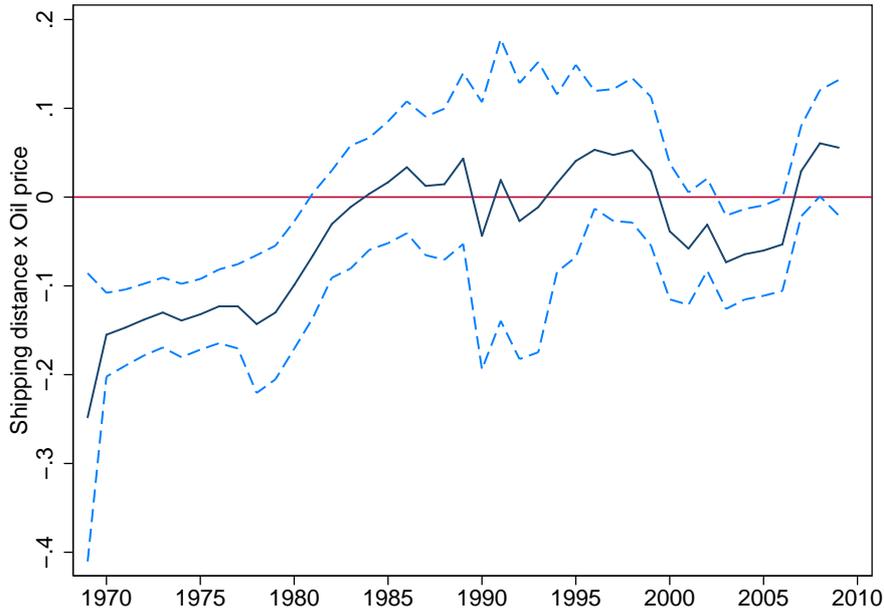


Note: The left panel graphs the coefficients in column 2 of Table 3. The solid line is the estimate, the dashed-lines show the 95% confidence interval. The right panel runs a running-line smoother with bootstrapped 95% confidence intervals through a scatter plot of distance elasticities estimated by year using Poisson pseudo maximum likelihood.

and -0.187 in the 2-way and 3-way fixed-effect models. They both suggest a downward bias in the OLS estimates, i.e. the distance elasticity appears to be more sensitive to oil prices according to the IV estimates. This confirms that a positive effect of demand for long-distance trade on oil prices may bias downward our estimates of the effect of the oil price on the distance elasticity of trade. More importantly, the IV results confirm the role of oil prices in shaping the geography of world trade. Columns 4 and 8 report the results of an OLS estimation on the IV-restricted sample (The IV does not cover the years 2009-2014). The results are close to the OLS on the full sample thus confirming that the IV results are not driven by sample selection.

As a further robustness check we estimate the specification in column 2 of Table 3 for overlapping 10 year-periods. Our aim is to check whether the oil-price-distance sensitivity has been changing over time. Changes in technology might have reduced the share of variable costs in overall shipping costs, decreasing the oil-price-distance sensitivity, or globalization may have increased the substitutability of goods across countries, increasing the oil-price-distance sensitivity. Results in Figure 3 suggest that the distance elasticity was significantly sensitive to the oil price from the end of the 1960s till the beginning of the 1980s, and again in the mid-2000s. The distance-elasticity's sensitivity to oil prices thus appears to matter more in periods of large price fluctuations, and hence was insignificant in the 1990s when the oil price remained around \$30. More importantly we notice no

Figure 3: Oil-price elasticity of the distance elasticity of trade across 10-year windows



Note: Rolling regressions for overlapping 10 year-periods. The specification is akin to that of column 2 in Table 3. The solid line is the estimates, and the dashed lines are 95% confidence intervals.

time trend in the interaction's coefficient, suggesting that despite technological progress and cultural changes in the world economy, oil prices continue to affect the geography of trade.

As a last robustness check, we estimate the model using disaggregated trade flows by SITC 1-digit product category (Table 2) to check whether the effects are heterogenous across categories. Detailed results are shown in Table 4. The 3-way fixed-effect model estimates interactions that vary between -0.183 for miscellaneous manufactured articles and -0.447 for heavy goods that are mostly shipped by boat, i.e. mineral fuels, lubricants, and related materials. These results suggest that ocean-shipped trade in heavy goods may be more sensitive to oil prices. These patterns are similar in the 2-way fixed effect results. Moreover, as the results are significant in 20 out of 20 industry-level regressions we can rule out that the results are driven by variation in goods-composition of trade.

Table 2: SITC classification

SITC	Description	% of 1962-2014 world trade	Oil-price-distance elasticity
0	Food and live animals	6.3	-0.195
1	Beverages and Tobacco	0.9	-0.288
2	Crude materials, inedible, except fuels	4.5	-0.152
3	Mineral fuels, lubricants, and related materials	15.4	-0.447
4	Animal and vegetable oils, fats and waxes	0.5	-0.281
5	Chemicals and related products	10.5	-0.256
6	Manufactured goods classified chiefly by material	13.5	-0.244
7	Machinery and transport equipment	33.6	-0.190
8	Miscellaneous manufactured articles	12.0	-0.183
9	Commodities and transactions N.E.S.	2.9	-0.243

Note: The oil-price-distance elasticities are estimated using the 3-way fixed effect specification and the full results of those regressions are in Table 4. All elasticity estimates are significant at the 1% percent level.

5 Welfare losses due to higher oil-price-induced home bias

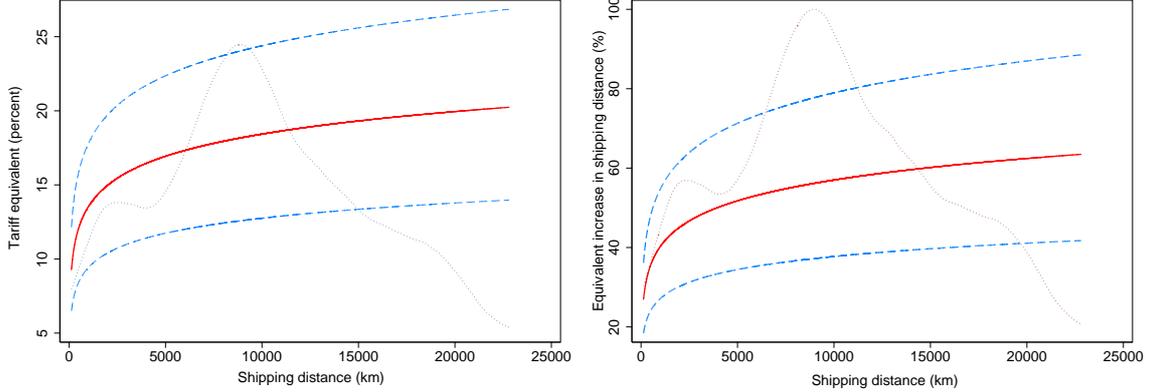
In this section we quantify the implications of the regression results. We start by estimating the tariff equivalent, as well as the distance increase equivalent, of an oil price increase from 100\$ to 200\$, something that could happen by 2030 according to the forecast of the US Energy Information Administration (EIA, 2013). As a second step we simulate the trade impact and resulting real-income losses due to the same oil price increase. To estimate the trade impact on welfare, we follow Head and Mayer (2013) and Arkolakis et al. (2012) and consider the general-equilibrium effects of the change in trade costs where wages (and therefore GDPs) also adjust to trade cost changes, and also taking into account price index changes.

We start from an estimation of the change in trade costs (\widehat{t}_{ij}), where, for any variable x , $\widehat{x} = x'/x$, and x' is the value of x after the shock. The change in trade costs can be obtained using the estimate on the interaction of distance and oil prices, as well as our chosen change in oil prices, i.e. from 100\$ to 200\$:

$$\widehat{t}_{ij} = e^{\frac{1}{\epsilon}(\beta_D \ln \widehat{D}_{ij})} \quad (5)$$

where ϵ is the trade elasticity for aggregate trade flows. We can easily compute \widehat{t}_{ij} using the β_D coefficient reported in column 7 of Table 3, i.e. the IV estimate from the specification including country-pair fixed effects. Eaton and Kortum (2012) suggest that the current best estimate sets $\epsilon = -4$.

Figure 4: Trade cost equivalents of an oil-price increase from 100 to 200\$



Note: The red blue line is the mean estimate and the dashed blue lines are 95% confidence intervals from regression 6 in Table 3. The dotted line is the density estimate of shipping distance.

The tariff equivalent of the trade cost increase can be computed as:

$$\tau_{ij} = \hat{t}_{ij} - 1 \quad (6)$$

In Figure 4 we plot the tariff equivalents against the distance between countries. We find the tariff equivalent, which is an increasing function of bilateral shipping distance, to be around 17%. This is much higher than the tariff equivalent of a \$50-per-ton carbon tax, which is estimated at 0.73% on average by Cristea et al. (2013). We also compute the percent increase in shipping distances that would be equivalent to the oil-price rise. While the oil-price rise imply an increase in trade costs due to an increase in distance elasticity, it can also be thought of as increases in shipping distance under a fixed distance elasticity of -1.5 (at \$100). According to our estimates the distance elasticity would reach -1.9 if the oil price reached \$200. The equivalent increased distances can thus be computed as:

$$EquivalentDistance_{ij} = \exp((1.9/1.5) \times \ln(D_{ij})) \quad (7)$$

An oil-price rise can thus be thought as an increase in shipping route, affecting longer routes even more. The resulting equivalent percent increase in shippingn routes is graphed in Figure 4.

To estimate the welfare effect we need to compute the change in trade patterns re-

sulting from the trade cost shocks⁶. The welfare effect takes the following form (see Proposition 2 in Arkolakis et al.):

$$\frac{\widehat{m}_{ij}}{y_i} = \frac{(\widehat{w}_j \widehat{t}_{ij})^\epsilon}{\sum_{j'=1}^n \frac{m_{ij'}}{y_i} (\widehat{w}_{j'} \widehat{t}_{ij'})^\epsilon} \quad (8)$$

Changes in trade patterns thus depend on the change in trade costs and on changes in wages, \widehat{w}_j , which are directly linked to real income in the Arkolakis et al. (2012)) model.⁷ The change in wages are implicitly given by:

$$\widehat{w}_j = \sum_{i'=1}^n \frac{m_{i'j} \widehat{w}_{i'} (\widehat{w}_j \widehat{t}_{i'j})^\epsilon}{y_j \sum_{j'=1}^n m_{i'j'} / y_{i'} (\widehat{w}_{j'} \widehat{t}_{i'j'})^\epsilon} \quad (9)$$

The general equilibrium trade impact can then be computed as:

$$\frac{\widehat{m}_{ij}}{y_i} \times \widehat{y}_i \quad (10)$$

Finally, according to proposition 1 in Arkolakis et al., assuming that trade is balanced, that the ratio of profits to total income is constant, and that the import demand system is such that bilateral trade flows are given by a gravity specification consistent with the presence of a single production factor (labor), we can express the welfare change as:

$$\widehat{W}_i = \left[\frac{\widehat{m}_{ii}}{y_i} \right]^{1/\epsilon} \quad (11)$$

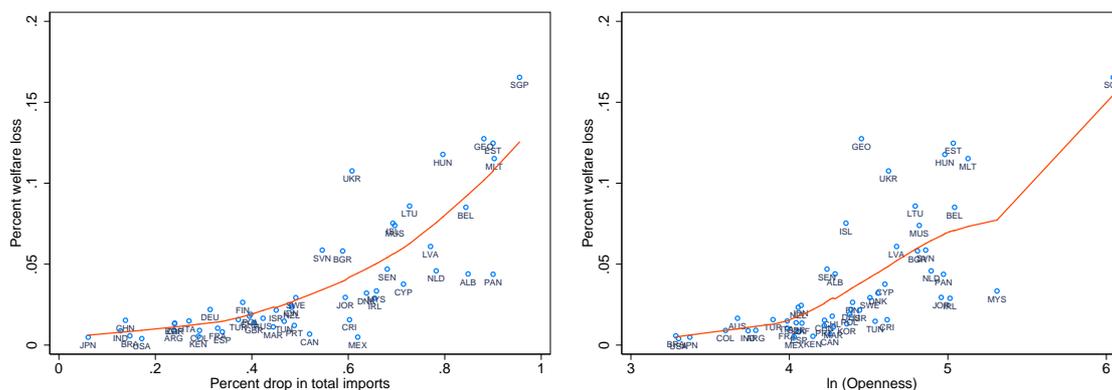
To calculate the changes in trade and welfare associated with an increased distance elasticity, we use the Stata code and dataset provided by Head and Mayer. The data provided by Head and Mayer is a cross section of trade in manufacturing products between 84 countries for the year 2000. We drop oil-exporting countries, i.e. those with oil rents above 10% of GDP on average over the period, to abstract from the transfer effect of higher oil prices, as well as landlocked countries. We are left with 52 countries. ‘Trade with self’ is inferred from production and export data.

The estimation is done in three steps. First we calculate the change in trade costs

⁶Note that the trade cost shock we take into account is the increase in distance elasticity, not the tariff equivalent, as the latter also involves tariff revenue that we would otherwise need to take into account.

⁷The model of Arkolakis et al. (2012) builds on Eaton and Kortum (2002) who first computed real wages as a function of import shares and the trade elasticity in order to quantify the gains from trade in a Ricardian model

Figure 5: Welfare losses of an oil-price increase from 100 to 200\$



caused by a change in oil prices from 100\$ to 200\$ as specified in equation (5). We use the distance-elasticity slope estimate reported in column 7 of Table 3, i.e. the IV estimate from the specification including country-pair fixed effects. Second, we plug these into equation (9) which defines a system of equations determining the changes in wages, i.e. (\widehat{w}_j) , which we solve by iteration. Thirdly, substituting these and the estimates of the changes in trade costs in equation (5) into (8) and the result into (11) yields the changes in welfare following a change in the distance elasticity of trade⁸.

Figure 5 summarizes the results. Welfare losses vary from 0.01% to 0.16% across countries. The panels show that the welfare loss is larger in open countries who would see a larger decline in imports. Head and Mayer use the same model to estimate the welfare gains due to gravity variables. They find that on average an trade agreement increases welfare by 1.1%, but NAFTA did by 4.8%. A common currency boosts it by 2.5%, and abolishing a border would boost it by about 20%. Costinot and Rodriguez-Clare (2013) suggest that the gains from international trade are about 1% in the US, 2.7% in Canada, 1.8% in France and 3% in Argentina. Hence, for an average country, a doubling of the oil price would have a non-negligible effect on trade-related welfare. But to put it differently, further trade liberalization could easily offset the negative impact of high oil prices on world trade.

⁸The welfare effects we estimate are not the total welfare effects of higher oil prices but only those induced by higher trade costs and only for non-oil-exporting countries. We abstract from the losses due to higher energy costs not related to transport, such as heating costs in winter.

6 Conclusion

We have shown that oil prices affect the geography of global trade, with trade on longer shipping routes being most affected. High oil prices in the future may indeed put the breaks on globalization as the distance elasticity of trade is higher in years of high oil prices. What we find is that a large increase in the price of oil, from 100\$ to 200\$, is akin to imposing a world-wide tariff around 17%. We then estimate that the real-income loss of such higher trade costs is around 0.03% in the average country, a sizeable amount given the level of overall gains from trade. Conversely, the recent drop in oil prices could be a boon for the integration of the global economy.

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Table 3: How the oil price increases the distance-elasticity of trade

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	1st stage	OLS	IV	OLS on IV sample	1st stage	OLS	IV	OLS on IV sample
	Distance \times oil price	Imports	Imports	Imports	Distance \times oil price	Imports	Imports	Imports
Distance \times oil price		-0.165*** (0.0160)	-0.271*** (0.0381)	-0.184*** (0.0163)		-0.106*** (0.0157)	-0.187*** (0.0356)	-0.111*** (0.0156)
Distance \times oil conflict	0.523*** (0.00352)				0.501*** (0.00406)			
Distance	2.875*** (0.00646)	-0.751*** (0.0694)	-0.376*** (0.135)	-0.690*** (0.0676)				
Border	0.0369*** (0.0137)	0.232 (0.180)	0.221 (0.187)	0.217 (0.186)				
Language	-0.00211 (0.00304)	1.342*** (0.0594)	1.352*** (0.0617)	1.353*** (0.0613)				
Colony	0.00759 (0.00594)	0.719*** (0.127)	0.757*** (0.131)	0.756*** (0.130)				
Legal system	-0.00140 (0.00196)	0.166*** (0.0403)	0.165*** (0.0420)	0.166*** (0.0417)				
Currency	-0.00752 (0.0179)	0.288* (0.158)	0.433** (0.193)	0.432** (0.191)	-0.363*** (0.0357)	0.204*** (0.0636)	0.270*** (0.0727)	0.297*** (0.0719)
FTA	0.0203*** (0.00383)	0.324*** (0.0649)	0.304*** (0.0680)	0.302*** (0.0676)				
Country-pair FE	No	No	No	No	Yes	Yes	Yes	Yes
Observations	334,009	383,576	334,009	334,009	334,809	384,428	334,809	334,809
R-squared	0.997	0.814	0.806	0.806	0.997	0.898	0.898	0.898

Dependent variable is bilateral imports. All regressions include importer-year and exporter-year fixed effects. The figures in parenthesis are country-pair clustered standard errors, and * stands for statistical significance at the 10% level, ** at the 5% level and *** at the 1% percent level.

Table 4: Robustness to the composition of trade

	(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Distance × oil price	-0.233*** (0.0170)	-0.294*** (0.0162)	-0.181*** (0.0151)	-0.440*** (0.0242)	-0.309*** (0.0179)	-0.266*** (0.0156)	-0.268*** (0.0154)	-0.205*** (0.0144)	-0.194*** (0.0136)	-0.263*** (0.0145)
Distance	-0.311*** (0.0724)	0.355*** (0.0662)	-0.543*** (0.0649)	-0.313*** (0.0957)	0.154** (0.0724)	-0.340*** (0.0642)	-0.307*** (0.0637)	-0.295*** (0.0579)	-0.275*** (0.0554)	0.220*** (0.0567)
Border	0.764*** (0.163)	1.045*** (0.150)	0.694*** (0.156)	1.107*** (0.218)	1.230*** (0.149)	0.836*** (0.157)	0.832*** (0.167)	1.037*** (0.156)	0.861*** (0.151)	0.621*** (0.129)
Language	1.012*** (0.0665)	0.769*** (0.0656)	0.864*** (0.0648)	0.315*** (0.0875)	0.598*** (0.0733)	0.958*** (0.0598)	1.123*** (0.0580)	0.913*** (0.0524)	1.115*** (0.0537)	0.423*** (0.0465)
Colony	1.018*** (0.148)	0.820*** (0.159)	0.781*** (0.124)	0.593*** (0.189)	0.856*** (0.155)	0.563*** (0.117)	0.658*** (0.127)	0.765*** (0.112)	0.766*** (0.108)	0.951*** (0.109)
Legal system	0.405*** (0.0454)	0.417*** (0.0452)	0.347*** (0.0441)	0.456*** (0.0655)	0.370*** (0.0535)	0.289*** (0.0400)	0.233*** (0.0385)	0.196*** (0.0345)	0.258*** (0.0338)	0.338*** (0.0346)
Currency	0.147 (0.172)	0.646*** (0.142)	-0.179 (0.188)	-0.0647 (0.201)	0.559*** (0.151)	0.520*** (0.172)	0.116 (0.170)	0.0159 (0.123)	0.293** (0.143)	0.917*** (0.114)
FTA	0.565*** (0.0695)	0.595*** (0.0664)	0.625*** (0.0670)	0.675*** (0.0908)	0.467*** (0.0692)	0.844*** (0.0640)	0.945*** (0.0638)	0.963*** (0.0559)	1.041*** (0.0562)	0.501*** (0.0524)
Observations	356,797	287,567	339,402	274,834	230,138	348,636	367,399	367,220	368,356	299,653
R-squared	0.727	0.672	0.720	0.584	0.615	0.785	0.802	0.841	0.837	0.705

Including country-pair fixed effects

Distance × oil price	-0.195*** (0.0152)	-0.288*** (0.0156)	-0.152*** (0.0143)	-0.447*** (0.0236)	-0.281*** (0.0174)	-0.256*** (0.0149)	-0.244*** (0.0145)	-0.190*** (0.0144)	-0.183*** (0.0132)	-0.243*** (0.0133)
Currency	0.494*** (0.0906)	0.0966 (0.133)	0.232*** (0.0901)	0.0703 (0.152)	0.799*** (0.128)	0.228*** (0.0849)	-0.187*** (0.0697)	-0.551*** (0.0765)	-0.358*** (0.0811)	0.824*** (0.142)
Observations	356,794	287,564	339,400	274,833	230,137	348,632	367,392	367,216	368,351	299,651
R-squared	0.858	0.831	0.853	0.755	0.786	0.885	0.896	0.909	0.919	0.820

Dependent variable is bilateral imports. The column number corresponds to the SITC product group. All regressions include importer-year and exporter-year fixed effects. The bottom part regressions include country-pair fixed effects as well. The figures in parenthesis are country-pair clustered standard errors, and * stands for statistical significance at the 10% level, ** at the 5% level and *** at the 1% percent level.