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# **OxCarre Research Paper 115**

## **The Trade Consequences of Pricey Oil**

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# The trade consequences of pricey oil

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## Abstract

This paper examines the trade and trade-induced welfare effects of high 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. We estimate that an increase in the oil price from 100\$ to 200\$ would have the similar effect as imposing a world-wide import tariff between 4% and 9%, depending on the distance between countries. In turn, such higher trade costs would lower welfare by 1.8% 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 consequences of such high oil prices on the world economy are many yet hard to pin down. In this paper we aim to identify one such effect, namely the trade consequence of higher shipping costs due to high

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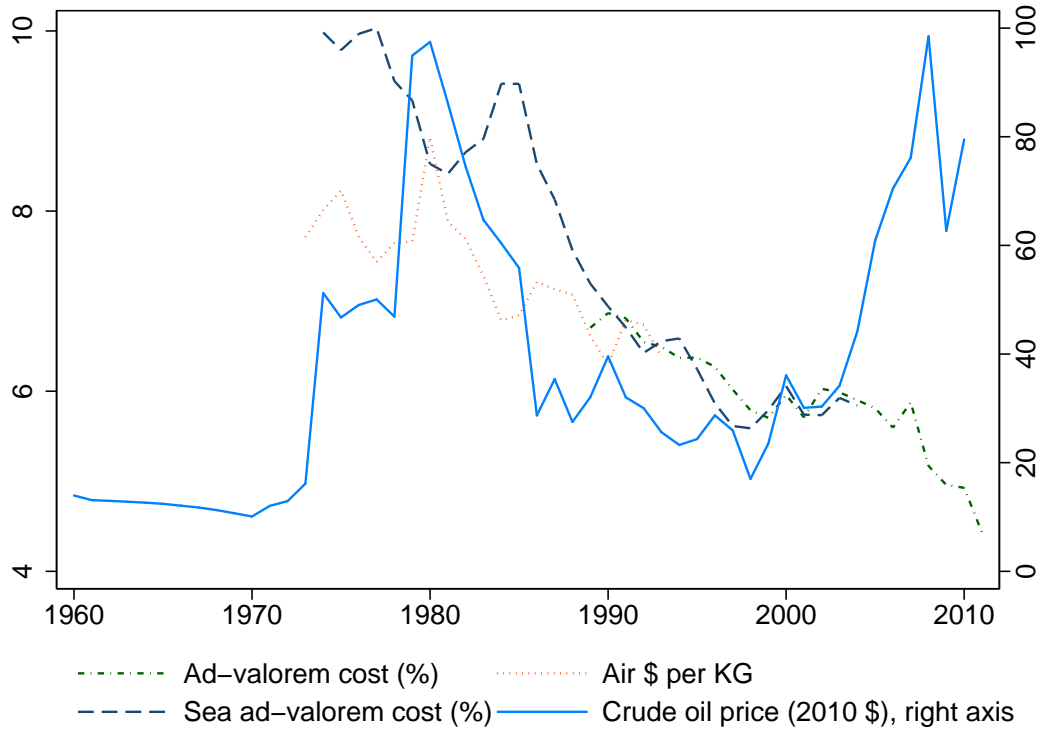
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oil prices. When the oil price reached its peak in 2008, Paul Krugman argued that “higher fuel prices are putting the brakes on globalization: if it costs more to ship stuff, there will be less shipping” (Krugman, 2008). The increase in trade costs 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). The consequences of persistently-high oil prices should thus be examined carefully.

The aim of this paper is to estimate the effect of oil prices on trade via the increase in transport 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 transport 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 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. 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 one identifying assumption 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 geographic distance between them, where distance is an exogenous measure of shipping costs. What’s more, the model allows us to control for any country-year shock with fixed effects, thus identifying 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

Figure 1: Shipping costs and oil prices



Note: The crude oil price is in 2010 USD 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.

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. 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.<sup>1</sup>

We estimate gravity equations using bilateral trade data for the whole world for the period 1962–2010 and find a significant interaction of distance with the oil price. 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 holds when we estimate the distance coefficients by year and regress them on oil prices. It also holds 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).

As the oil-price elasticity of trade may vary according to the mode of transport, we estimate the model on land-intensive, sea-intensive and air-intensive imports separately, using rules-of-thumb from the literature. What we find is that the distance elasticity of air imports is much less sensitive to oil prices than that of sea trade. This may be because oil accounts for a lower share of air trade value. The coefficient on land-transport imports suggests land transport may be even more sensitive to oil prices. Yet this result is not robust.

As a further robustness check, we estimate the model using disaggregated trade flows by product category to check whether the effects are heterogeneous. We find significant interactions in all categories.

To quantify our results we estimate the tariff equivalent of an oil increase from 100\$ to 200\$ using trade elasticity estimates from the literature. We find that this price hike could have the same effect on trade as imposing a tariff of around 6%, depending on the distance between countries and the trade elasticity. We then plug this change in trade costs into the formula proposed by Arkolakis et al. (2012) to calculate the welfare loss due to lower gains from trade. We find that in the average non-oil-exporting country, welfare

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<sup>1</sup>Our 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.

may be 1.8% lower than it would have been if oil prices had remained at 100\$. We find that the most open countries would lose most.

The reminder 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.<sup>2</sup> If this is indeed the case, high oil prices would imply de-globalization and a re-bundling of production and consumption. This is what we aim to investigate further in this paper. A report by the investment

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<sup>2</sup>Assche 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.

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.

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 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 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  $j$ ,  $\epsilon$  is the trade cost elasticity of bilateral imports, and  $P_i$  and  $\Pi_j$  are the multilateral resistance terms in the importing (inward) and exporting (outward) country, respectively.<sup>3</sup>

We follow the literature and model bilateral trade costs ( $t_{ij}$ ) as a function of geographic 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  $\alpha$ s are parameters and  $D_{ij}$  is the geographic 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  $\beta$ 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:

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<sup>3</sup>The 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  $\alpha_{it}$  and  $\sigma_{jt}$  are importer-year and exporter-year fixed effects. In a more demanding version of the model, we also include country-pair fixed effects, and hence only the interaction of distance with the oil price remains on the right-hand side:

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

For our gravity regressions we use annual bilateral trade data for the whole world covering 1962–2010 from UN Comtrade, oil price data from the BP Review, and geographic distances as well as the other controls are from CEPII.

## 4 Results

Results of the baseline estimate are in the first column in Table 2. We find a negative and significant coefficient of -0.19 on the interaction of distance and oil prices. This suggests that when oil prices are lower, trade is more global. Results in column 5, which include country-pair fixed effects, confirm the result, albeit reducing the interaction coefficient to -0.02<sup>4</sup>.

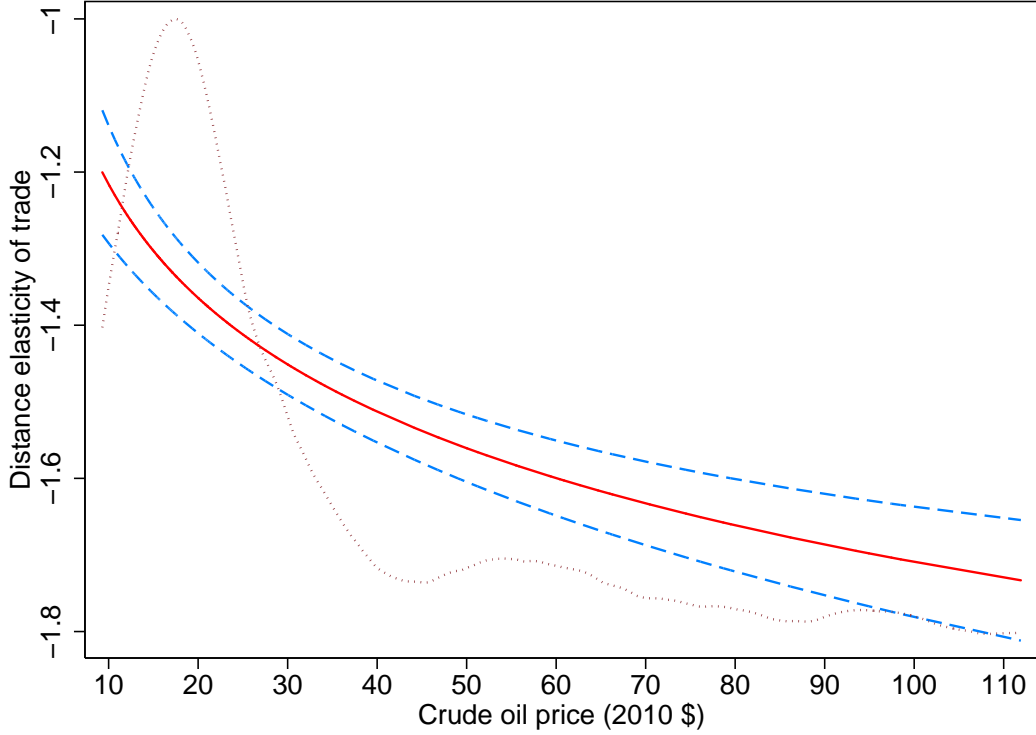
Figure 2 describes the results of the first column of Table 2. When the price of oil is at \$20 a barrel, the distance elasticity of trade is at -1.4. When the oil price increases to \$100, the distance elasticity increases to -1.7. In other words, low oil prices make the world smaller. As a robustness check, we also estimate the distance elasticity by year (using OLS as well as Poisson PML<sup>5</sup>) and plot the obtained coefficient against the average oil price in

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<sup>4</sup>Only the results in column 1 allow for estimates of the level of the distance elasticity, on top of its slope, across oil prices. The -0.19 coefficient on the interaction yields distance elasticities between -1.2 and -1.7, close to the estimates obtained when estimating gravity equations by year, (see the left panel of Fig. 3.) The -0.02 coefficient is more precisely identified due to the inclusion of country-pair fixed effects and is close to what was found for China’s exports by Assche et al. (2011) (-0.043). We thus use the latter estimate in our quantification exercise.

<sup>5</sup>The 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

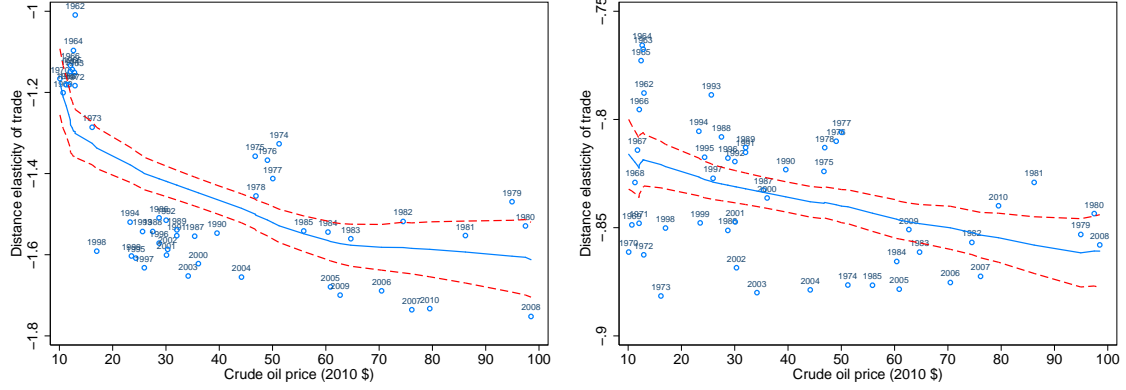


Note: The dashed-lines show the 95% confidence interval. The dotted line is the kernel density estimate of oil prices.

the corresponding year (Figure 3). 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.

The oil-price elasticity of trade may vary according to the mode of transport. Yet, there is no available data on trade by transport mode for the whole world. We thus focus on land-intensive, sea-intensive and air-intensive imports separately, using rules-of-thumb from the literature. Hummels (2007) suggests that 90% of trade with land neighbors is done by surface modes like truck, rail, and pipeline while nearly all trade with nonadjacent partners moves via ocean and air modes. We thus compute land-intensive imports as all imports between adjacent countries. Hummels also points out that bulk commodities like oil and petroleum products, iron ore, coal, and grains are shipped almost exclusively via ocean cargo. We thus focus on imports in the SITC category (3) and on countries that do not share a border to compute sea-intensive imports. To compute air-intensive imports

Figure 3: Distance elasticity of trade across years



Note: The left-hand chart gives the OLS estimates, the right-hand side the Poisson. The solid blue lines are running-line smoothers, and the dashed red lines are bootstrapped 95% confidence intervals.

we focus on SITC category (7) which, according to Harrigan (2010) has the highest share of air transport, at 43% in 2003. We also focus on the period after 1999 when air shipping accounted for more than 50% of US export value.

The results of these regressions are in columns (2) to (4) and (6) to (8) of Table 2. What we find is that the distance elasticity of air-intensive imports is much less sensitive to oil prices than that of sea trade, with respective interaction coefficients of -0.17 against -0.32 (in the two-way fixed-effects model). This may be because oil accounts for a lower share of air trade value. The coefficient on land-transport imports suggests land transport maybe even more sensitive to oil prices. Yet this result is not robust to the 3-way fixed effects. This may be because distances between neighboring countries are a poor indicator of transport costs.

As a robustness check, we estimate the model using disaggregated trade flows by SITC 1-digit product category (Table 1) to check whether the effects are heterogenous across categories. Results are in Table 3. We find a significant interaction that varies between -0.018 for miscellaneous manufactured articles and -0.18 for heavy goods that are mostly shipped by boat, i.e. mineral fuels, lubricants, and related materials. We find the interaction to be insignificant for ‘Machinery and transport equipment’ (SITC 7), suggesting the geography of trade in these goods is not affected by oil prices. This is probably due to a high value-to-weight ratio in this category (Cristea et al., 2013). These results again suggest that ocean-shipped trade is more sensitive to oil prices.

Table 1: SITC classification

SITC	Description	% of world trade
0	Food and live animals	12.79
1	Beverages and Tobacco	7.03
2	Crude materials, inedible, except fuels	11.1
3	Mineral fuels, lubricants, and related materials	5.78
4	Animal and vegetable oils, fats and waxes	4.70
5	Chemicals and related products	11.14
6	Manufactured goods classified chiefly by material	13.71
7	Machinery and transport equipment	13.19
8	Miscellaneous manufactured articles	13.73
9	Commodities and transactions N.E.S.	6.82

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

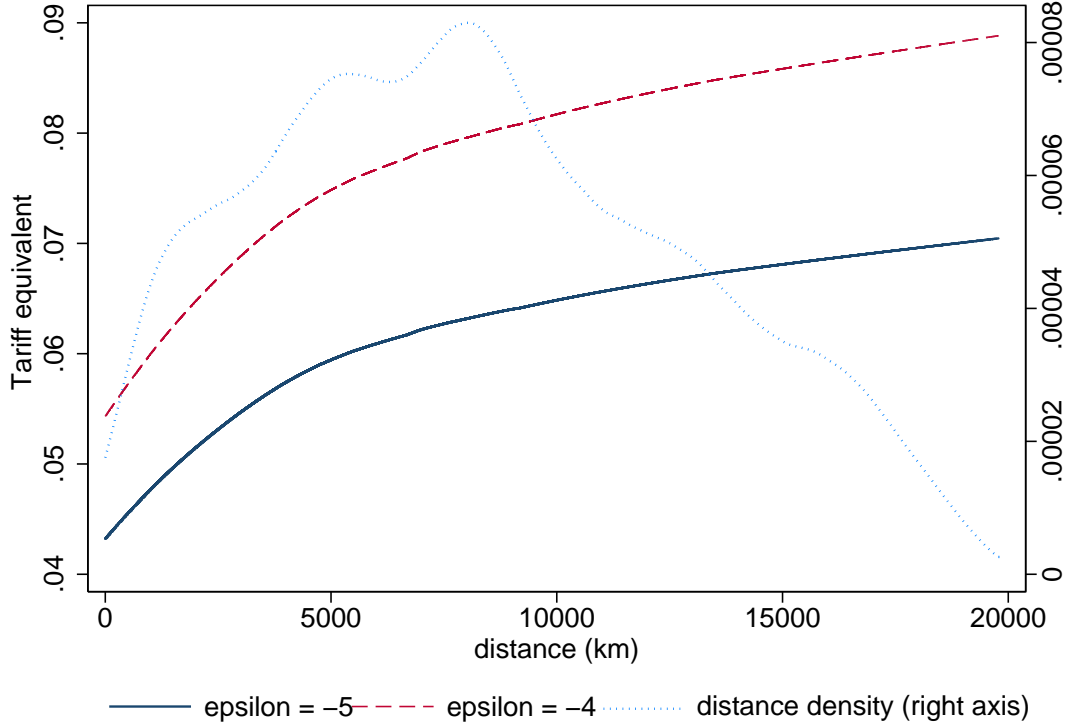
In this section we quantify the implications of the regression results. We start by estimating the tariff equivalent of an oil price increase from 100\$ to 200\$, something that could happen by 2030 according to the forecast of the US Energy Information Administration (EIA, 2013). As a second step we simulate the trade impact and resulting real-income losses due to the same oil price increase. To estimate the trade impact, we follow Head and Mayer (2013) who in turn follow 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 ( $\hat{t}_{ij}$ ), where, for any variable  $x$ ,  $\hat{x} = x'/x$ , 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\$:

$$\hat{t}_{ij} = e^{\frac{1}{\epsilon}(\beta_O \ln \hat{O} \ln D_{ij})} \quad (5)$$

where  $\epsilon$  is the trade elasticity for aggregate trade flows. We can easily compute  $\hat{t}_{ij}$  using the  $\beta_D$  coefficients reported in column (5) of Table 2 and  $\epsilon$  estimates from the literature. Head and Mayer suggest that the current best estimate sets  $\epsilon = -5$ , Eaton and Kortum (2012) suggest  $\epsilon = -4$ . The tariff equivalent of the trade cost increase can then be computed as:

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



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

In Figure 4 we plot the tariff equivalents against the distance between countries using the two estimates of the trade elasticity. We find the tariff equivalent to be around 6%. 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).

Changes in trade patterns resulting from trade cost shocks take the following form (see Proposition 2 in Arkolakis et al.):

$$\frac{\widehat{m}_{ij}}{y_i} = \frac{(\widehat{w}_j \widehat{t}_{ij})^\epsilon}{\sum_{j'=1}^n \frac{m_{ij'}}{y_i} (\widehat{w}_j' \widehat{t}_{ij'})^\epsilon} \quad (7)$$

The estimation of the change in wages,  $\widehat{w}_j$ , requires solving the general-equilibrium wages of all countries in our sample:

$$\widehat{w}_j = \sum_{i'=1}^n \frac{m_{i'j} \widehat{w}_{i'} \left( \widehat{w}_j \widehat{t}_{i'j} \right)^\epsilon}{y_j \sum_{j'=1}^n m_{i'j'} / y_{i'} \left( \widehat{w}_{j'} \widehat{t}_{i'j'} \right)^\epsilon} \quad (8)$$

The general equilibrium trade impact can then be computed as:

$$\frac{\widehat{m}_{ij}}{y_i} \times \widehat{y}_i \quad (9)$$

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:

$$\widehat{W}_i = \left[ \frac{\widehat{m}_{ii}}{y_i} \right]^{1/\epsilon} \quad (10)$$

To calculate the changes in trade and welfare associated with an increased distance elasticity, we solve the  $n$  non-linear equations for the changes in wages ( $\widehat{w}_j$ ) using 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, to abstract from the transfer effect of higher oil prices. 72 countries are left. ‘Trade with self’ is inferred from production and export data. Substituting these and the estimates of the changes in trade costs in equation (5) into (7) and the result into (10) yields the changes in welfare following a change in the distance elasticity of trade<sup>6</sup>.

Figure 5 summarizes the results. The top panel shows that the change in the share of expenditure on home goods increases by 5% on average and that this increase is highest for the most open economies. The bottom panel illustrates that the average drop in imports would be around 55%, corresponding to an average welfare loss of around 1.8% in non-oil-exporting countries<sup>7</sup>. Head and Mayer use the same model to estimate the welfare

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<sup>6</sup>The welfare effects we estimate are not the total welfare effects of higher oil prices but only estimates for non-oil-exporting countries. Furthermore, we look only at the trade effect of higher shipping costs, i.e. we abstract from the losses due to higher energy costs not related to transport, such as heating up the business in winter.

<sup>7</sup>We can use estimates from oil companies to confirm the range of our welfare estimates. The Exxon-Mobil Energy Outlook (2013) suggests that about 45 millions of oil-equivalent barrels per day were needed for transportation in 2010. If the price of oil reaches \$200 from \$100, our estimates suggest the average drop in imports would be around 55%. If we assume that oil demand for transport would also fall by 55%,

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 about the same trade-cost effect on welfare as removing a free-trade agreement and would take a bit chunk out of current gains from trade. But to put it differently, further trade liberalization could easily offset the negative impact of high oil prices on world trade.

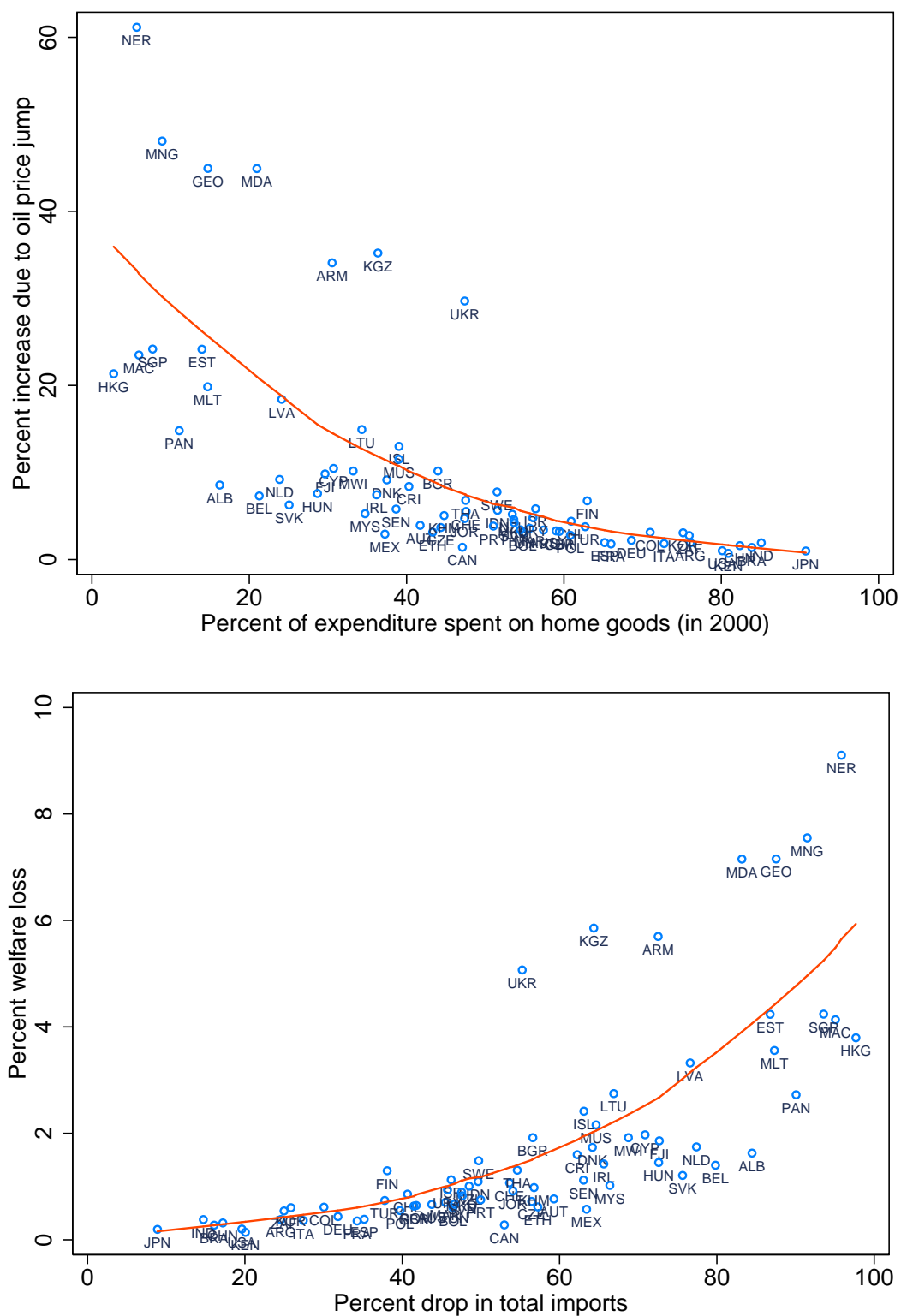
## 6 Conclusion

We have shown that persistently-high oil prices 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 of between 4% and 9%, the higher the longer the distance between countries. We then estimate that the real-income loss of such higher trade costs is around 1% in the average country, equivalent to removing an average trade agreement. This negative impact could thus easily be offset by further trade liberalization.

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only about 2 billion barrels would be required. The non-oil-exporting world welfare loss would thus be between \$2 and \$4.5 billion per day, or between about \$0.7 and \$1.6 trillion a year, that is between 1.1% and 2.5% of world GDP. This confirms that our 1.8% average estimate is of the right order of magnitude.

Figure 5: Trade and real-income losses of an oil-price increase from 100 to 200\$





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Table 2: How the oil price increases the distance-elasticity of trade

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Total	Land	Sea	Air	Total	Land	Sea	Air
	imports	imports	imports	imports	imports	imports	imports	imports
Distance $\times$ oil price	-0.187*** (0.00922)	-0.460** (0.192)	-0.324*** (0.0158)	-0.165*** (0.00761)	-0.0213*** (0.00494)	-0.0966*** (0.0234)	-0.163*** (0.00906)	-0.00526 (0.00428)
Distance	-0.846*** (0.0370)	0.384 (0.775)	-0.623*** (0.0586)	-0.591*** (0.0302)				
Language	1.041*** (0.0315)	-0.688** (0.294)	0.197*** (0.0537)	0.785*** (0.0273)				
Colony	1.193*** (0.103)	-0.250 (0.219)	0.788*** (0.161)	0.984*** (0.0952)				
Border	0.750*** (0.116)							
Observations	1,012,721	16,348	467,592	881,142	1,012,721	16,348	467,592	881,142
Country-pair FE	NO	NO	NO	NO	YES	YES	YES	YES

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 3: Robustness to the composition of trade

	(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Distance $\times$ oil price	-0.0521*** (0.00530)	-0.0677*** (0.00574)	-0.0754*** (0.00545)	-0.184*** (0.00905)	-0.116*** (0.00727)	-0.0486*** (0.00505)	-0.0674*** (0.00475)	-0.00284 (0.00442)	-0.0181*** (0.00434)	-0.0610*** (0.00496)
Observations	823,016	553,620	733,795	482,345	395,513	784,143	880,541	894,683	897,368	605,739

Dependent variable is bilateral imports. The column number corresponds to the SITC product group. All regressions include importer-year and exporter-year fixed effects as well as country-pair 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.