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ABSTRACT

To what extent do nations' economic interests influence their political behavior? To shed light on this question, we develop new theory-consistent measures of the sensitivity of country welfare to foreign productivity growth. We derive these measures from the class of international trade models with a constant trade elasticity. Using exogenous sources of variation from both China's emergence into the global economy and reductions in the cost of air travel over time, we show that as a country becomes more economically dependent on a trade partner, it realigns politically towards that trade partner.

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1 Introduction

“Throughout history, anxiety about decline and shifting balances of power has been accompanied by tension and miscalculation ... Traditionally the test of a great power was its strength in war. Today, however, the definition of power is losing its emphasis on military force ... The factors of technology ... and economic growth are becoming more significant in international power.” (Nye 1990, pp. 153-4)

To what extent do nations’ economic interests influence their political behavior? We provide new theory and evidence on this question by developing model-consistent measures of the sensitivity of welfare in one country to productivity growth in another country. We derive these measures from first-order general equilibrium comparative statics in the class of international trade models with a constant trade elasticity. We introduce a bilateral friend-enemy representation of these comparative statics, where one country is a friend [enemy] for income or welfare in another country if its productivity growth raises [reduces] the income or welfare of the other country. Using China’s emergence into the global economy as a natural experiment, we show that as countries become more economically dependent on China relative to the United States over time, they realign politically away from the United States and towards China, with this pattern particularly strong for South-East Asian and resource-rich African countries. More generally, using exogenous variation in bilateral trade costs from the declining cost of air travel, we show that as a country’s welfare becomes more exposed to productivity growth in another nation, it realigns politically towards that nation, along a range of measures including United Nations voting, strategic rivalries and formal alliances.¹

Analyzing the relationship between economic and political interests raises several challenges. First, there is the problem of measuring the sensitivity of one country’s welfare to productivity growth in another country. Some studies use bilateral trade. However, one country’s economic exposure to another does not only depend on bilateral trade frictions, but also on trade frictions with other nations. Even taking this multilateral resistance into account yields an incomplete picture, because productivity growth in trade partners typically has other general equilibrium effects through the terms of trade. Another approach is to undertake model-based counterfactuals for productivity shocks. However, this approach is also difficult, because political behavior does not only depend on the shocks that actually occurred, but also on those that could have occurred. For example, even the threat of reduced access to a country’s market can induce changes in behavior, but such counterfactual shocks are high-dimensional and typically unobserved.

¹Recent work emphasizing links between economics and politics includes research on trade and war (Martin et al. 2008), institutions and development (Acemoglu et al. 2001; Dell et al. 2018), foreign aid and development (Kuziemko and Werker 2006; Nunn and Qian 2014); and economic networks and conflict (König et al. 2017).

Our new exposure measures address these challenges. First, our measures equal the elasticities of country welfare with respect to foreign productivity growth in the class of international trade models with a constant trade elasticity. Therefore, they correspond exactly to the theoretically-consistent measure of the *sensitivity* of country welfare with respect to productivity growth in this influential class of models. Second, we can compute these sensitivity measures directly from observed trade data alone, without having to measure actual shocks or predict counterfactual shocks. Third, since our measures are derived from the general equilibrium conditions of this class of models, they capture not only multilateral resistance but all first-order general equilibrium effects. Finally, although in theory our sensitivity measures are based on a linearization and are thus exact only for small shocks, we show in practice that they closely approximate the full non-linear model solution even for large shocks, such as cumulative productivity changes over our sample period of more than forty years.

We begin by showing that the sensitivity of one country’s income or welfare with respect to a productivity or trade cost shock in another country can be recovered from the share of each importer’s expenditure on each exporter, the share of each exporter’s income derived from selling to each importer, and the constant trade elasticity. Relative to existing research on sufficient statistics in international trade, our key new insight is that the first-order comparative statics in constant elasticity trade models can be stacked into a matrix that captures the effect on each country (rows) of shocks in any other country (columns). We thus obtain our friend-enemy representation, where one country is a friend [enemy] for income or welfare in another country if its productivity growth raises [reduces] the income or welfare of the other country.

An advantage of this approach is that we recover the entire bilateral network of country income and welfare exposure to productivity growth from a single matrix inversion. We are thus able to use techniques from the networks literature to characterize the role of countries’ positions within the network in influencing the effects of productivity and trade cost shocks. We evaluate the extent to which each country’s productivity growth affects others (its “authority score” from graph theory) and the extent to which each country is affected by others’ productivity growth (its “hub score” from graph theory). We thus provide new data on countries’ roles in the global economy, both in terms of our measures of income and welfare exposure, and the network statistics derived from them. Our use of the terms “friends” and “enemies” echoes its use in neoclassical trade theory for the general equilibrium relationships between factor and goods prices, or goods outputs and factor endowments.

We combine our economic exposure measures with a range of different measures of countries’ political alignment. First, we use three different measures of the bilateral similarity of countries’ voting patterns in the United Nations General Assembly (UNGA). Second, we use measures of countries’ “ideal points” or preferences relative to the US-led liberal order, based on the UNGA

voting data. Third, we use measures of strategic rivalries, based on the perceptions of contemporary political decisions, as to whether countries regard one another as actual or latent threats. We further disaggregate these strategic rivalries into those that are positional, spatial and ideological. Finally, we use measures of formal alliances between countries, including mutual defense pacts, neutrality and non-aggression treaties and ententes.

We document large-scale changes in welfare exposure and political alignment over our more than forty-year sample period from 1970-2012. Following China's liberalization in 1978, we observe the largest increases in exposure to its productivity growth for South-East Asian countries and resource-rich emerging countries. In the South-East Asian countries, Chinese productivity growth promotes the development of electrical and machinery sectors through input-output linkages, whereas in the resource-rich emerging countries, it leads to an expansion of extractive industries such as mining. As countries' exposure to Chinese productivity growth increases relative to their exposure to US productivity growth, we find that they realign politically from United States and towards China. We show that this political realignment is particularly strong for African and Asian countries, and weaker for American and European countries, which on average benefit less from China's growth by our sensitivity measures.

In addition to this evidence from the natural experiment of China's emergence into the global economy, we also examine the broader relationship between economic and political interests across countries. A key challenge here is that causality can run in both directions, or both variables can be influenced by omitted third factors. We address this challenge in a number of ways. First, we exploit variation over time within country-partner pairs, which controls for a host of time-invariant factors that are specific to individual pairs of countries (e.g. geographical location, institutions, legal origin, common language etc). Second, we include exporter-year and importer-year fixed effects, which control for the sign and absolute magnitude of actual or expected exporter productivity growth, as well as policy changes that are common to all trade partners and macro shocks. Third, we follow the recent international trade literature in constructing an instrument for bilateral changes in economic exposure using the dramatic decline in the cost of air travel that occurred over sample period. Using differential changes in trade costs between long and short distances, we find that increases in bilateral welfare exposure raise bilateral political alignment. We show that these results are robust across a range of different econometric specifications (including panel and long-differences regressions) and measures of bilateral political alignment (including UN voting, strategic rivalries and formal alliances).

We first introduce our friend-enemy exposure measures for the influential class of single-sector models with a constant trade elasticity. We show that whether one country is a friend or enemy of another depends on three effects in this class of models. First, there is a *market size effect*: as productivity growth in a foreign country changes income in all markets around the

world, it changes the size of the market for domestic goods. Second, there is a *cross-substitution effect*: productivity growth in a foreign country directly enhances the price competitiveness of that country's goods, and indirectly changes the price competitiveness of all countries' goods through changes in income, which induces substitution between domestic and foreign goods. Third, there is a *cost of living effect*: these direct and indirect changes in price competitiveness also affect the cost of living in all countries. Our income exposure measure depends on the first two effects, while our welfare exposure measure depends on all three.

We next show that this same friend-enemy representation holds across a wide range of specifications, including a state of the art quantitative trade model with multiple sectors and input-output linkages. We use this quantitative specification for our main empirical results and report a number of further validation exercises. First, we show that our exposure measures are not well proxied by simpler measures of economic relationships between countries, such as bilateral trade flows. Second, we provide evidence that our model-based exposure measures have predictive power for separate data not used in their estimation. We show that our exposure measures both predict country selection into preferential trade agreements (PTAs) and detect increases in economic interdependence following the formation of these PTAs. Third, to address the concern that there could be important non-linearities, we show that our linearization closely approximates comparative statics from the full non-linear model solution using the cumulative changes in productivity over our more than forty-year sample period.

Our research contributes to several strands of existing work. First, our paper is related to research on international political economy. One strand of this research has measured countries' bilateral political alignment using data on the similarity of their voting patterns in the United Nations General Assembly (UNGA), including [Scott \(1955\)](#), [Cohen \(1960\)](#), [Signorino and Ritter \(1999\)](#), [Häge \(2011\)](#) and [Dicaprio and Sokolova \(2018\)](#). Much of this literature focuses on the bilateral similarity of these voting patterns. In contrast, [Bailey et al. \(2017\)](#) uses information on the issues voted on to estimate countries' "ideal points," which correspond to their positions vis-a-vis the US-led liberal order.² Another line of this research has measured countries' bilateral political alignment using data on strategic rivalries, based on the perceptions of contemporary political decision makers, including [Thompson \(2001\)](#), [Colaesi et al. \(2010\)](#) and [Aghion et al. \(2018\)](#). Another branch of work has used data on formal alliances between countries, including [Eisensee and Strömberg \(2007\)](#), [Gartzke \(2007\)](#) and [de Mesquita and Siverson \(1995\)](#). A further vein of this research measures bilateral political attitudes using survey data and other information, including [Alesina and Spolaore \(2003\)](#), [Guiso et al. \(2009\)](#), [Head et al. \(2010\)](#), [Head and Mayer \(2013\)](#) and

²Using UN and US data, [Kuziemko and Werker \(2006\)](#) shows that aid to a country increases when it rotates onto the Security Council. Using US aid data, [Nunn and Qian \(2014\)](#) shows that an increase in food aid increases the incidence and duration of civil conflicts. Using trade data, [Meyerson et al. \(2008\)](#) examines the impact of China's demand for natural resources on human rights in Sub-Saharan Africa.

Bao et al. (2019). Our key contribution relative to this literature is to examine the relationship between these measures of bilateral political alignment and our new measures of the extent to which countries are economic friends and enemies.³

Second, our research connects with the empirical literature on war and trade. One strand of this work looks at the causal impact of war on trade, including Blomberg and Hess (2006) and Glick and Taylor (2010). Another line of this work looks at the opposite causal relationship of trade on the probability of conflict, including Polachek (1980), Mansfield (1995) and Barbieri (2002). Combining these two strands, Martin et al. (2008) provide theory and evidence that globalization *decreases* the likelihood of *global* conflict, but *increases* the chance of *bilateral* conflict, because globalization increases countries' multilateral dependence on one another as a whole, but decreases a country's bilateral dependence on any one trade partner. Although the use of military force is the ultimate expression of political power, it is relatively rare. Furthermore, the international relations literature emphasizes softer forms of political power, including international agreements, supra-national institutions, and back-room diplomacy (see for example Nye 1990). We provide new theory and evidence on the extent to which these softer forms of political power are influenced by economic interests.

Third, we build on the empirical literature that has developed instrumental variables for bilateral international trade, including Frankel and Romer (1999), Rodriguez and Rodrik (2001) and Feyrer (2019). Fourth, we also build on research on quantitative models and sufficient statistics in international trade, including Armington (1969), Jones and Scheinkman (1977), Wilson (1980), Eaton and Kortum (2002), Anderson and van Wincoop (2003), Arkolakis et al. (2012), Costinot et al. (2012), Caliendo and Parro (2015), Adão et al. (2019), Baqaee and Farhi (2019), Huo et al. (2019) and Caliendo et al. (2019).⁴ Our key new insight is that the first-order comparative statics in constant elasticity trade models can be stacked into a matrix that captures the effect on each country (rows) of shocks in any other country (columns). Using this friend-enemy representation, we recover the entire network of bilateral sensitivity of income and welfare to foreign productivity growth from a single matrix inversion. We use these bilateral exposure measures to provide new evidence on the extent to which exogenous increases in the degree to which countries are economic friends lead them to become greater political friends.

The remainder of the paper is structured as follows. Section 2 derives our economic friends and enemies measures. Section 3 introduces our data. Section 4 reports our main empirical re-

³Several authors have drawn parallels between the current China-US tensions and earlier episodes of changing relative economic size, such as Japan and the United States in the 1980s, Britain and Germany at the turn of the 20th century, or Athens and Sparta in Ancient Greece. See Brunnermeier et al. (2018) and "China-US rivalry and threats to globalization recall ominous past," Martin Wolf, *Financial Times*, 26th May, 2020.

⁴The earlier theoretical literature on foreign productivity growth and domestic welfare includes the classic contributions of Hicks (1953), Johnson (1955) and Bhagwati (1958).

sults on economic and political friends. Section 5 reports further specification checks. Section 6 concludes. A separate online appendix contains the derivations of the results in the paper, the proofs of the propositions, and a number of further extensions.

2 Economic Friends and Enemies

In this section, we introduce our new friend-enemy representation of first-order comparative statics in constant elasticity trade models. We first develop our approach for an influential class of single-sector models. We next derive our measures for a state of the art quantitative trade model with multiple sectors and input-output linkages. For simplicity, we focus on Armington trade models, in which goods are differentiated by origin. In Section C of the online appendix, we demonstrate isomorphisms with the entire class of trade models with a constant trade elasticity.

2.1 Model

We consider a world of many countries indexed by $n, i \in \{1, \dots, N\}$. Each country has an exogenous supply of ℓ_n workers, who are each endowed with one unit of labor that is supplied inelastically. Goods are differentiated by country of origin and the representative consumer in country n is assumed to have constant elasticity of substitution (CES) preferences, such that the indirect utility function (u_n) takes the following form:

$$u_n = \frac{w_n}{\left[\sum_{i=1}^N p_{ni}^{-\theta} \right]^{-\frac{1}{\theta}}}, \quad \theta = \sigma - 1, \quad \sigma > 1, \quad (1)$$

where w_n is the wage; p_{ni} is the price in country n of the good produced in country i ; $\sigma > 1$ is the elasticity of substitution and $\theta = \sigma - 1$ is the trade elasticity. Using Roy's Identity, country n 's share of expenditure on the good produced by country i (s_{ni}) is:

$$s_{ni} = \frac{p_{ni}^{-\theta}}{\sum_{m=1}^N p_{nm}^{-\theta}}. \quad (2)$$

Each country's good is produced with labor according to a constant returns to scale production technology, with productivity z_i in country i . Markets are perfectly competitive. Goods can be traded between countries subject to iceberg trade costs, such that $\tau_{ni} \geq 1$ units of a good must be shipped from country i in order for one unit to arrive in country n (where $\tau_{ni} > 1$ for $n \neq i$ and $\tau_{nn} = 1$). The cost in country n of consuming one unit of the good produced by country i is:

$$p_{ni} = \frac{\tau_{ni} w_i}{z_i}. \quad (3)$$

Goods market clearing requires that income in country i equals the expenditure on goods produced by that country:

$$w_i \ell_i = \sum_{n=1}^N s_{ni} w_n \ell_n, \quad (4)$$

where we begin by assuming for simplicity that is balanced, before later generalizing our approach to allow for trade imbalances. Finally, we choose world GDP as the numeraire:

$$\sum_{n=1}^N w_n \ell_n = 1. \quad (5)$$

Using these components of the model, we are now in a position to define general equilibrium.

Definition. Given fundamentals, i.e., the set of country-level productivities $\{z_i\}$ and bilateral trade costs $\{\tau_{ni}\}$, the general equilibrium of the model is the collection of factor prices $\{w_i\}$, goods prices $\{p_{ni}\}$, and expenditure shares $\{s_{ni}\}$, and welfare $\{u_n\}$ that satisfy equations (1)-(5).

Substituting the expenditure share (2) and pricing rule (3) into the market clearing condition (4), we can reduce the general equilibrium of the model to a single system of N equations that uniquely determines the N wages in each country.

2.2 First-Order Comparative Statics

We next derive familiar first-order comparative statics in this class of constant elasticity trade models,⁵ before introducing our new friend-enemy representation in the next section. Totally differentiating the expenditure share (2), the pricing rule (3) and the market clearing condition (4), the change in country income per capita satisfies:

$$d \ln w_i = \sum_{n=1}^N t_{in} \left(d \ln w_n + \theta \left(\sum_{h=1}^N s_{nh} [d \ln \tau_{nh} + d \ln w_h - d \ln z_h] - [d \ln \tau_{ni} + d \ln w_i - d \ln z_i] \right) \right), \quad (6)$$

where we have held country labor endowments constant ($d \ln \ell_i = 0$) and the share of value added that country i derives from each market n is defined as:

$$t_{in} \equiv \frac{s_{ni} w_n \ell_n}{w_i \ell_i}.$$

Totally differentiating the indirect utility function (1), the change in country welfare equals the change in income per capita minus the expenditure share weighted average of price changes:

$$d \ln u_n = d \ln w_n - \sum_{i=1}^N s_{ni} [d \ln \tau_{ni} + d \ln w_i - d \ln z_i]. \quad (7)$$

⁵See, for example, [Jones and Scheinkman \(1977\)](#), [Wilson \(1980\)](#), [Arkolakis et al. \(2012\)](#), [Adão et al. \(2019\)](#), [Baqae and Farhi \(2019\)](#), and [Huo et al. \(2019\)](#).

2.3 Friends-and-Enemies Representation

The key new insight of our approach is that these first-order comparative statics can be stacked into a matrix that captures the effect on each country (rows) of shocks in any other country (columns). We thus obtain our friend-enemy representation, where one country is a friend [enemy] for income or welfare in another country if its productivity growth raises [reduces] the income or welfare of the other country. After stacking these comparative statics in this way, we recover the entire bilateral network of country income and welfare exposure to shocks from a single matrix inversion problem. We focus from now onwards on productivity shocks, in line with our empirical application, but we derive analogous expressions for bilateral trade costs in Section D.1 of the online appendix.

We use boldface, lowercase letters for vectors, and boldface, uppercase letters for matrices. We use the corresponding non-bold, lowercase letters for elements of vectors and matrices. We use \mathbf{I} to denote the $N \times N$ identity matrix.

Expenditure Share and Income Share Matrices Let $\mathbf{S} \equiv [s_{ni}]$ be the $N \times N$ matrix with the ni -th element equal to importer n 's expenditure share on exporter i . Let $\mathbf{T} \equiv [t_{in}]$ be the $N \times N$ matrix with the in -th element equal to the fraction of income that exporter i derives from selling to importer n . We refer to \mathbf{S} as the *expenditure share* matrix and to \mathbf{T} as the *income share* matrix. Intuitively, s_{ni} captures the importance of i as a *supplier* to country n , and t_{in} captures the importance of n as a *buyer* for country i . Note the order of subscripts: in matrix \mathbf{S} , rows are buyers and columns are suppliers, whereas in matrix \mathbf{T} , rows are suppliers and columns are buyers. Both matrices have rows that sum to one. For theoretical completeness, we maintain two assumptions on \mathbf{S} , which are satisfied empirically in all years of our data: for any i, n , there exists $k \in \mathbb{Z}^+$ such that $[\mathbf{S}^k]_{in} > 0$; (ii) for all $i, s_{ii} > 0$. The first assumption states that all countries are connected through trade, *directly* or *indirectly*.⁶ The second assumption states that every country consumes a positive amount of domestic goods.

Let $\mathbf{q} \equiv [w_i \ell_n]$ be the $N \times 1$ vector with the i -th element equal to country i 's income relative to world GDP. We refer to \mathbf{q} simply as the *income vector*.

The \mathbf{q} vector and the \mathbf{S} and \mathbf{T} matrices are all equilibrium objects that can be obtained directly from observed trade data. We now establish the relationship between these equilibrium objects under our assumption of balanced trade, and derive the analogous relationship under trade imbalance in Section D.2.3 of the online appendix.

⁶Theoretically, this assumption is important because shocks propagate in general equilibrium through changes in relative prices, which are only well-defined if countries are connected (potentially indirectly) to each other through trade. When the global trade network has disconnected components—for instance, if a subset of countries only trade among themselves but not with other nations, or if some countries are in autarky—our results can be applied to study the general equilibrium propagation of shocks within each of the connected components separately.

Lemma 1. *Assuming that trade is balanced, \mathbf{q}' is the unique left-eigenvector of both \mathbf{S} and \mathbf{T} , with corresponding eigenvalue of one: $\mathbf{q}'\mathbf{S} = \mathbf{q}'\mathbf{T} = \mathbf{q}'$. Furthermore, if there is free-trade (i.e. $\tau_{ni} = 1$ for all n, i), \mathbf{q}' is equal to every row of \mathbf{S} and of \mathbf{T} .*

Proof. See Section B.10 of the online appendix. □

Lemma 1 shows that, under balanced trade, one can recover \mathbf{q} and \mathbf{T} from the expenditure share matrix \mathbf{S} . Therefore, \mathbf{S} is a sufficient statistic for the general equilibrium effect of small productivity shocks on income and welfare under balanced trade.

Friends-and-Enemies for Income We now derive our friends-and-enemies matrix representation for bilateral income exposure to productivity shocks. We begin by stacking the comparative statics for income in equation (6) in matrix form, and we denote $\mathbf{M} \equiv \mathbf{T}\mathbf{S} - \mathbf{I}$:

$$\underbrace{d \ln \mathbf{w}}_{\text{income effect}} = \underbrace{\mathbf{T} d \ln \mathbf{w}}_{\text{market-size effect}} + \underbrace{\theta \cdot \mathbf{M} \times (d \ln \mathbf{w} - d \ln \mathbf{z})}_{\text{cross-substitution effect}}. \quad (8)$$

The income comparative statics in equation (8) have an intuitive interpretation. The first term on the right-hand side captures a *market-size effect*. If the productivity shocks raise income in another country n , this raises income in country i through increased expenditure on its goods. The magnitude of this effect depends on the share of income that country i derives from country n (as captured by the matrix \mathbf{T}).

The second term on the right-hand side captures a cross-substitution effect, where the in -th element of the cross-substitution matrix ($\mathbf{M} \equiv \mathbf{T}\mathbf{S} - \mathbf{I}$) is given by $m_{in} \equiv \sum_{h=1}^N t_{ih}s_{hn} - 1_{n=i}$. For $i \neq n$, the sum $\sum_{h=1}^N t_{ih}s_{hn}$ captures the overall competitive exposure of country i to country n , through each of their common markets h , weighted by the importance of market h for country i 's income (t_{ih}). As the competitiveness of country n increases, as measured by a decline in its wage relative to its productivity ($d \ln w_n - d \ln z_n$), consumers in all markets h substitute towards country n and away from other countries $i \neq n$, thereby reducing income in country i and raising it in country n . With a constant elasticity import demand system, the magnitude of this cross-substitution effect in market h depends on the trade elasticity (θ) and the share of expenditure in market h on the goods produced by country n (s_{hn}): consumers in market h increase expenditure on country n by $(s_{hn} - 1)$ and lower expenditure on country i by s_{hn} . Summing across all markets h , we obtain the overall impact on country i 's income.

Using our matrix representation of the income comparative statics in equation (8), we can immediately recover the elasticity of each country's income with respect to a productivity shock in any country from a simple matrix inversion problem.

Proposition 1. *The elasticities of each country’s income with respect to productivity shocks in any country satisfy:*

$$d \ln \mathbf{w} = \mathbf{W} d \ln \mathbf{z}, \quad (9)$$

$$\mathbf{W} \equiv -\frac{\theta}{\theta+1} (\mathbf{I} - \mathbf{V})^{-1} \mathbf{M}, \quad \mathbf{V} \equiv \frac{\mathbf{T} + \theta \mathbf{TS}}{\theta+1} - \mathbf{Q},$$

where \mathbf{Q} is an $N \times N$ matrix with the income row vector \mathbf{q}' stacked N times.

Proof. The Proposition follows from equations (8), using our choice of world GDP as numeraire ($\mathbf{Q} d \ln \mathbf{w} = \mathbf{0}$), as shown in Section B of the online appendix. \square

The elements of the matrix \mathbf{W} capture countries’ bilateral income exposure to productivity shocks. In particular, the in -th element of this matrix is the elasticity of income in country i (row) with respect to a small productivity shock in country n (column). We refer to country n as being a “friend” of country i for income when this elasticity is positive and an “enemy” of country i for income when this elasticity is negative. In general, \mathbf{W} is not necessarily symmetric: i could view n as a friend, while n views i as an enemy.

Our choice of world GDP as the numeraire implies that $\sum_{i=1}^N q_i d \ln w_i = 0$ or $\mathbf{Q} d \ln \mathbf{w} = \mathbf{0}$, where \mathbf{Q} is an $N \times N$ matrix with the income row vector \mathbf{q}' stacked N times. The presence of the term \mathbf{Q} in the definition of the matrix \mathbf{V} in Proposition 1 reflects this choice of numeraire. Without this term, the matrix $(\mathbf{I} - \frac{\mathbf{T} + \theta \mathbf{TS}}{\theta+1})$ is not invertible, because the income shares and expenditure shares sum to one ($\sum_{n=1}^N t_{in} = 1$ and $\sum_{n=1}^N s_{ni} = 1$), which implies that the rows of $\frac{\mathbf{T} + \theta \mathbf{TS}}{\theta+1}$ sum to one and the columns of $(\mathbf{I} - \frac{\mathbf{T} + \theta \mathbf{TS}}{\theta+1})$ are not linearly independent. This non-invertibility reflects the fact that the trade share matrices \mathbf{T} , \mathbf{S} and \mathbf{M} are homogeneous of degree zero, which implies that income can only be recovered from these trade shares up to a normalization or choice of units. Although we choose world GDP as a convenient numeraire, all of our predictions for relative country incomes are invariant to the choice of numeraire.

Since the spectral radius (largest absolute eigenvalue) of the matrix \mathbf{V} is less than one, the matrix inversion in Proposition 1 has a power-series or Neumann-series representation:

$$\mathbf{W} = -\frac{\theta}{\theta+1} (\mathbf{I} - \mathbf{V})^{-1} \mathbf{M} = -\frac{\theta}{\theta+1} \sum_{k=0}^{\infty} \mathbf{V}^k \mathbf{M} = -\underbrace{\frac{\theta}{\theta+1} \mathbf{M}}_{\text{partial equilibrium}} - \underbrace{\frac{\theta}{\theta+1} (\mathbf{V} + \mathbf{V}^2 + \dots)}_{\text{general equilibrium}} \mathbf{M}. \quad (10)$$

In this representation, the overall first-order impact is expressed in terms of a partial equilibrium effect, which captures the direct impact of the productivity shocks at initial prices, and general equilibrium effects, which capture the endogenous adjustment of prices.

Friends-and-Enemies for Welfare We next stack the comparative statics for welfare in equation (7) in matrix form:

$$\underbrace{d \ln \mathbf{u}}_{\text{welfare effect}} = \underbrace{d \ln \mathbf{w}}_{\text{income effect}} - \underbrace{\mathbf{S} (d \ln \mathbf{w} - d \ln \mathbf{z})}_{\text{cost-of-living effect}}. \quad (11)$$

Again the welfare comparative statics in equation (11) have an intuitive interpretation. The change in welfare depends on the change in income and a cost of living effect, which reflects the impact of the productivity shocks on the price index in each country. This cost of living effect depends on the share of expenditure (s_{ni}) that each country n allocates to all countries i , as captured in the \mathbf{S} matrix.

Using our matrix representation of the welfare comparative statics in equation (11) and Proposition 1, we can immediately recover the elasticity of each country’s welfare with respect to a productivity shock in any country:

Proposition 2. *The elasticities of each country’s welfare with respect to a productivity shock in any country satisfy:*

$$d \ln \mathbf{u} = \mathbf{U} d \ln \mathbf{z}. \quad (12)$$

$$\mathbf{U} \equiv (\mathbf{I} - \mathbf{S}) \mathbf{W} + \mathbf{S}.$$

Proof. The proposition follows from Proposition 1 and equation (11), as shown in Section B of the online appendix. \square

The elements of the matrix \mathbf{U} capture countries’ bilateral welfare exposure to productivity shocks. In particular, the ni -th element of this matrix is the elasticity of welfare in country n (row) with respect to a small productivity shock in country i (column). We refer to country i as being a “friend” of country n for welfare when this elasticity is positive and an “enemy” of country n for welfare when this elasticity is negative. As for income exposure, welfare exposure \mathbf{U} is not necessarily symmetric: i could view n as a friend, while n views i as an enemy. Unlike the income exposure, which captures nominal effects of productivity shocks and thus depends on the choice of numeraire, the welfare exposure in Proposition 2 captures real effects of productivity shocks and is thus invariant to our choice of numeraire.⁷

Our welfare exposure measure in Proposition 2 has a number of advantages from the point of view of our empirical application. First, we are concerned with the relationship between bilateral political alignment and the *sensitivity* of welfare in one country with respect to productivity

⁷To see this, note expenditure shares sum to one for each importer, i.e. the row-sum of \mathbf{S} is one. Therefore, adding any constant vector \mathbf{k} to changes in log per capita incomes ($d \ln \mathbf{w} = d \ln \mathbf{w} + \mathbf{k}$) leaves the welfare effect in equation (11) unchanged (since $\mathbf{k} - \mathbf{S}\mathbf{k} = \mathbf{0}$).

growth in another country. As our closed-form solutions in Proposition 2 are *elasticities* of welfare in one country with respect to productivity growth in another country, they correspond exactly to the theoretically-consistent sensitivity measure in this class of models with a constant trade elasticity. Second, we can compute these sensitivity measures directly from the observed trade data alone. Therefore, we are not required to measure actual productivity growth or counterfactual shocks in order to compute our sensitivity measures.

Although our exposure measures are exact for small shocks, there in principle could be non-linearities, in which case our exposure measures could be misleading for sensitivity to large shocks. To address this concern, we report a validation exercise in Section 5 below, in which we compare the predictions of our linearization to the full non-linear model solution. Even for cumulative productivity shocks over the entire of our sample period from 1970-2012, we find that our linearization provides a close approximation to the full non-linear model solution. Therefore, our closed-form solutions successfully capture sensitivity to both small and large shocks.

Multiple Sectors and Input-Output Linkages To illustrate our approach as clearly as possible, we have so far developed our results for the influential class of single-sector trade models with a constant trade elasticity. We now show that our approach generalizes to a state of the art quantitative international trade model with multiple sectors and input-output linkages. The preferences of the representative consumer in country n are now defined across a number of sectors k according to a Cobb-Douglas functional form:

$$u_n = \frac{w_n}{\prod_{k=1}^K \left[\sum_{i=1}^N (p_{ni}^k)^{-\theta} \right]^{-\alpha_n^k / \theta}}, \quad \sum_{k=1}^K \alpha^k = 1, \quad \theta = \sigma - 1, \quad \sigma > 1. \quad (13)$$

where $\sigma > 1$ is the elasticity of substitution between country varieties and $\theta = \sigma - 1$ is the trade elasticity.

Each country's good within each sector is competitively produced using labor and composite intermediate inputs according to a constant returns to scale technology. Goods are again subject to iceberg trade costs, such that $\tau_{ni}^k \geq 1$ units must be shipped from country i to country n in sector k in order for one unit to arrive (where $\tau_{ni}^k > 1$ for $n \neq i$ and $\tau_{nn}^k = 1$). Therefore, the cost to a consumer in country n of purchasing a good from country i within sector k is:

$$p_{ni}^k = \tau_{ni}^k c_i^k, \quad c_i^k = \left(\frac{w_i}{z_i^k} \right)^{\gamma_i^k} \prod_{j=1}^K (P_i^j)^{\gamma_i^{k,j}}, \quad \sum_{k=1}^K \gamma_i^{k,j} = 1 - \gamma_i^k, \quad (14)$$

where c_i^k denotes the unit cost function for sector k and country i ; γ_i^k is the share of labor in production costs in sector k in country i ; $\gamma_i^{k,j}$ is the share of materials from sector j used in sector k in country i ; and z_i^k captures value-added productivity in sector k in country i .

Totally differentiating the goods market clearing condition and the indirect utility function, and stacking these comparative statics in matrix form, we obtain analogous elasticities of each country's income and welfare with respect to a common productivity shock across sectors in any country, as shown in Section D.6 of the online appendix. Again we can recover these exposure measures from a simple matrix inversion problem, as in the single-sector model above, and summarized in the following proposition.

Proposition 3. *The elasticities of each country's income with respect to common productivity shocks across sectors ($d \ln z_i^k = d \ln z_i$) in any country satisfy:*

$$d \ln \mathbf{w} = \mathbf{W} d \ln \mathbf{z}, \quad (15)$$

$$\mathbf{W} \equiv -\frac{\theta}{\theta + 1} (\mathbf{I} - \mathbf{V})^{-1} \mathbf{M}, \quad \mathbf{V} \equiv \frac{\mathbf{T} + \theta \mathbf{T} \mathbf{S}}{\theta + 1} - \mathbf{Q},$$

$$d \ln \mathbf{u} = \mathbf{U} d \ln \mathbf{z}, \quad (16)$$

$$\mathbf{U} \equiv (\mathbf{I} - \mathbf{S}) \mathbf{W} + \mathbf{S}.$$

where the expenditure share matrix (\mathbf{S}), income share matrix (\mathbf{T}) and cross-substitution matrix (\mathbf{M}) are now:

$$\mathbf{S}_{ni} \equiv \sum_{h=1}^N \sum_{k=1}^K \alpha_n^k s_{nh}^k \Lambda_{hi}^k, \quad \mathbf{T}_{in} \equiv \sum_{h=1}^N \sum_{k=1}^K \Pi_{ih}^k \vartheta_{hn}^k, \quad \mathbf{M}_{in} \equiv \sum_{h=1}^N \sum_{k=1}^K \sum_{o=1}^N \Pi_{io}^k \left(\vartheta_{oh}^k + \sum_{j=1}^N \Theta_{oh}^{kj} \right) \Upsilon_{hon}^k,$$

where Λ_{hi}^k captures the share of revenue in industry k in country h that is spent on value-added in country i ; Π_{ih}^k is the network-adjusted income share that country i derives from selling to industry k in country h ; ϑ_{hn}^k is the share of revenue that industry k in country h derives from selling to country n ; Θ_{oh}^{kj} captures the fraction of revenue in industry k in country o derived from selling to producers in industry j in country h ; and Υ_{hon}^k captures the responsiveness of country h 's expenditure on industry k in country o with respect to a shock to costs in country n .

Proof. See Section D.6 of the online appendix. □

Our closed-form solutions for each countries' exposure to foreign productivity shocks again depend on only observed trade matrices and the structural parameters of the model. But the expenditure share (\mathbf{S}), income share (\mathbf{T}) and cross-substitution (\mathbf{M}) matrices are now constructed differently. As a result of input-output linkages, the elements of all three matrices must be adjusted to take into account the network structure of production, using the observed industry-to-industry flows in the input-output matrix. For the \mathbf{S} and \mathbf{T} matrices that capture the share of an importer's expenditure on each exporter and the share of an exporter's income derived from each

importer, respectively, this is largely a matter of accounting. We take into account that the gross value of trade from exporter i to importer n in industry k includes not only the direct value-added created in this exporter and industry but also indirect value-added created in previous stages of production. For the \mathbf{M} matrix, this adjustment also takes into account that the effect of a foreign productivity shock now differs depending on whether it reduces intermediate input costs or competitors' output prices.

Exposure Network A distinctive feature of our approach is that we recover the entire network of bilateral income (\mathbf{W}) and welfare (\mathbf{U}) exposure from a single matrix inversion. Therefore, our exposure measures lend themselves to the use of techniques from the networks literature to characterize the role of countries' positions within the network in influencing the effects of productivity and trade cost shocks. In particular, we use the authority and hub scores from [Kleinberg \(1999\)](#), which are generalizations of the centrality measures used for symmetric networks. These generalizations take into account that the network is asymmetric and hence the direction of relationships matters. The authority score captures the extent to which a country affects others, while the hub score captures the extent to which a country is influenced by others.

More formally, the hub and authority scores for welfare exposure can be retrieved as the dominant eigenvector of $\mathbf{U}\mathbf{U}'$ and $\mathbf{U}'\mathbf{U}$, respectively, such that $\mathbf{a} \propto \mathbf{U}'\mathbf{U}\mathbf{a}$ and $\mathbf{h} \propto \mathbf{U}\mathbf{U}'\mathbf{h}$. Therefore, we can write these hub and authority scores, $\{h_i, a_i\}_{i=1}^N$, as follows:

$$a_i = \lambda \sum_{n=1}^N \mathbf{U}_{ni} h_n, \quad h_n = \mu \sum_{i=1}^N \mathbf{U}_{ni} a_i, \quad (17)$$

where λ and μ are scaling constants that are equal to the inverse norms of the vectors $\mathbf{a} \equiv [a_i]$ and $\mathbf{h} \equiv [h_n]$, respectively. From the bilateral country-partner network of exposure, we can thus obtain measures for each country of the extent to which it influences others and the extent to which it is influenced by others, for both income and welfare exposure.

Extensions In the online appendix, we report a number of further extensions and generalizations of our approach. In [Section D.1](#), we derive analogous income and welfare exposure measures for reductions in bilateral trade costs. In [Section D.2](#), we show that our approach naturally accommodates trade imbalances, following the standard approach in the quantitative trade literature of treating these trade imbalances as exogenous. In [Section D.3](#), we consider a multi-sector model without an input-output structure. In [Section D.4](#), we show that our analysis can be further generalized to allow for heterogeneous trade elasticities (θ^k) across sectors k . In [Section E](#), we consider a neoclassical trade model with a variable trade elasticity, and derive sensitivity bounds for our exposure measures with respect to departures from a constant trade elasticity.

3 Data

In this section, we discuss our economic and political data, while further information on the data sources and definitions is provided in Section I of the online appendix.

3.1 Economic Data

Our data on international trade are from the NBER World Trade Database, which reports values of bilateral trade between countries for around 1,500 4-digit Standard International Trade Classification (SITC) codes. The ultimate source for these data is the United Nations COMTRADE database and we use an updated version of the original dataset from Feenstra et al. (2005) for the time period 1970-2012.⁸ We augment these trade data with information on countries' gross domestic product (GDP), population and geographical characteristics from the GEODIST and GRAVITY datasets from CEPII.⁹ We measure bilateral air distance as the population-weighted average of the bilateral distances between countries' largest cities. We measure bilateral sea distance as the least-cost path by sea between countries' largest ports, for all bilateral pairs of countries that are connected by sea, as in Feyrer (2019).

We construct expenditure on domestic goods (X_{nnt}) using information on gross output, exports and imports, as discussed further in Section I of the online appendix. In our multi-sector models, we distinguish 20 tradeable and 20 non-tradeable sectors according to the International Standard Industrial Classification (ISIC). In our input-output specification, we use a common input-output matrix for all countries, based on the median input-output coefficients across the country sample in Caliendo and Parro (2015).¹⁰ We use these datasets to construct the S , T and M matrices for both the single-sector model (Propositions 1 and 2) and the multi-sector model with input-output linkages (Proposition 3). Our baseline sample consists of a balanced panel of 143 countries over the 43 years from 1970-2012.

We combine these international trade data with the World Bank's "Content Of Deep Trade Agreements" database (Hofmann et al. 2017).¹¹ This database covers 279 agreements signed by 189 countries between 1958 and 2015, which reflects the entire set of preferential trade agreements (PTAs) in force and notified to the World Trade Organization as of 2015. Our main PTA measure

⁸See <https://cid.econ.ucdavis.edu/wix.html>.

⁹See http://www.cepii.fr/cepii/en/bdd_modele/bdd.asp.

¹⁰In Section I of the online appendix, we report a robustness test, in which we construct domestic expenditure shares and country-specific input-output tables using the EORA Global Supply Chain Database (<https://www.worldmrio.com/>), for the shorter time period (1990-2015) and more aggregated industry classification for which these data are available. We find a strong correlation between our baseline measures using the NBER World Trade Database data and those using the EORA database where both data are available, for our input-output measures of income (W^{IO}) and welfare (U^{IO}) exposure, and expenditure (S^{IO}) and income shares (T^{IO}).

¹¹See <https://datacatalog.worldbank.org/dataset/content-deep-trade-agreements>.

is an indicator variable that equals one if a pair of countries participates in a PTA in a given year and zero otherwise.

3.2 Political Data

We use a number of different measures of countries' bilateral political alignment from the political science and international relations literature. First, we use data on observed voting behavior in the United Nations General Assembly (UNGA) to reveal countries' bilateral political alignment. Second, we use measures of strategic rivalries, as classified by political scientists, based on contemporary perceptions by political decision makers. Third, we use information on formal alliances, including mutual defense pacts, neutrality and non-aggression treaties and ententes. A key advantage of each of these measures relative to data on military conflict is that much international political influence does not involve open hostilities, including international treaties, other supra-national agreements, international institutions, and back-room diplomacy.

United Nations Voting Country votes in the UNGA are recorded as “no” (coded 1), “abstain” (coded 2) or “yes” (coded 3). Our first measure of the similarity of countries' bilateral political attitudes is the S -score of [Signorino and Ritter \(1999\)](#), which equals one minus the sum of the squared actual deviation between a pair of countries' votes scaled by the sum of the squared maximum possible deviations between their votes. By construction, this S -score measure is bounded between minus one (maximum disagreement) and one (maximum agreement).

A limitation of this S -score measure is that it does not control for properties of the empirical distribution function of country votes. In particular, country votes may align by chance, such that the frequency with which any two countries agree on a “yes” depends on the frequency with which each country individually votes “yes.” Therefore, we also consider two alternative measures of bilateral voting similarity that control in different ways for properties of the empirical distribution of votes. First, the π -score of [Scott \(1955\)](#) adjusts the observed variability of the countries' voting similarity using the variability of each country's own votes around the average vote for the two countries taken together. Second, the κ -score of [Cohen \(1960\)](#) adjusts this observed variability of the countries' voting similarity with the variability of each country's own votes around its own average vote.

Finally, a potential limitation of these three measures of the bilateral similarity of voting patterns is that they do not control for heterogeneity in the resolutions being voted on. To address this concern, [Bailey et al. \(2017\)](#) use the observed UN votes to estimate a time-varying measure of each country's political preferences or “ideal points.” They show that these ideal points consistently capture the position of states vis-à-vis the US-led liberal order. We use this approach to derive a measure of bilateral distance between countries' political attitudes by taking the absolute

difference between the ideal points of countries i and j in each year t .

Strategic Rivalries Our second set of measures of countries' bilateral political alignment are indicator variables that pick up whether country i is a strategic rival of j in year t , as classified by [Thompson \(2001\)](#) and [Colaresi et al. \(2010\)](#). These rivalry measures capture the risk of conflict with a country of significant relative size and military strength, based on contemporary perceptions by political decision makers, gathered from historical sources on foreign policy and diplomacy. Specifically, rivalries are identified by whether two countries regard each other as competitors, a source of actual or latent threats that pose some possibility of becoming militarized, or enemies. These rivalries are also further disaggregated into the following different types: (i) positional, where rivals contest relative shares of influence over activities and prestige within a system or subsystem; (ii) spatial, where rivals contest the exclusive control of a territory; and (iii) ideological, where rivals contest the relative virtues of different belief systems relating to political, economic or religious activities.

Strategic rivalry is much more prevalent than military conflict, as shown in [Aghion et al. \(2018\)](#). In our sample from 1970-2012, we find that a total of 42 countries have had at least one strategic rival; 74 country-pairs have been strategic rivals at some point; and the total number of country-pair-years that exhibit strategic rivalry is 2,452. For example, China is classified as a strategic rival of the U.S. (1970–1972 and 1996–present), India (the entire sample period), Japan (1996–present), the former Soviet Union (1970–1989), and Vietnam (1973–1991). By comparison, the United States is coded as a strategic rival of China (1970-72 and 1996-2012), Cuba (1970-2012), and the former Soviet Union (1970-89 and 2007-2012).

Formal Alliances Our third set of political alignment measures are indicator variables for whether country i is in a formal alliance with country j in year t from the Correlates of War Formal Alliances v4.1 ([Gibler 2008](#)). This dataset records all formal alliances among states between 1816 and 2012, including mutual defense pacts, neutrality and non-aggression treaties, and ententes. A defense pact is the highest level of military commitment, requiring alliance members to come to each other's aid militarily if attacked by a third party. Neutrality and non-aggression pacts pledge signatories to either remain neutral in case of conflict or not use force against the other alliance members. Ententes obligate members to consult in times of crisis or armed attack. Over our entire sample period from 1970-2012, 1,946 country-pairs are in a formal alliance, and 117 countries have at least one formal ally. In the year 2010, China had four allies: Iran, North Korea, Russia, and Pakistan. In contrast, the United States was in alliance with 49 nations in the same year, a significantly greater number than the median country, which has 10 allies.

4 Economic and Political Friends and Enemies

In this section, we present our main empirical results using our quantitative specification with multiple sectors and input-output linkages from Proposition 3. In Section 4.1, we introduce our economic exposure measures. We document a large-scale change in patterns of economic exposure following China’s emergence into the global economy. In Section 4.2, we introduce our political friends and enemies measures. We establish a political realignment of countries’ away from the United States and towards China as they have become more exposed to Chinese productivity growth relative to that of the United States. In Subsection 4.3, we estimate the relationship between political and economic interests across all countries, using variation in the impact of bilateral distance on bilateral trade flows from reductions in the cost of air travel.

4.1 Economic Friends and Enemies

We first present some summary statistics on our economic exposure measures, before turning to the impact of China’s emergence into the global economy on these exposure measures.

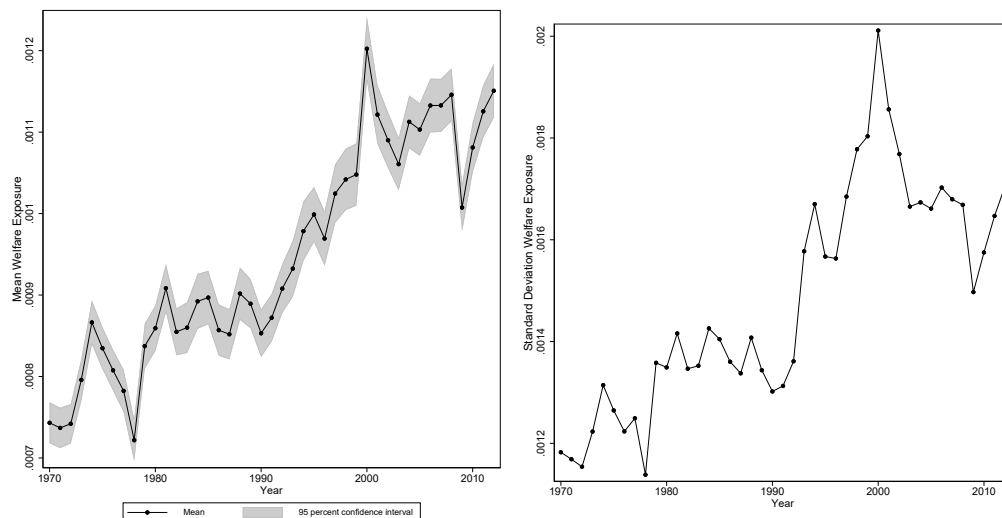
Global Welfare Exposure In Figure 1, we show the mean and standard deviation of welfare exposure to foreign productivity shocks (excluding own productivity shocks). Four main features are apparent. First, we find that on average foreign productivity shocks raise domestic welfare, because the net effect of the market-size, cross-substitution and cost of living effects is typically positive.¹² Second, we find that the mean elasticity is small, because foreign trade is a small share of income for most countries, most individual trade partners are a small share of foreign trade, and many individual trade relationships have zero flows.¹³ Third, we observe substantial heterogeneity in welfare exposure across individual pairs of trading partners, with the standard deviation larger than the mean. Fourth, we observe an increase in both the mean and standard deviation of welfare exposure over time, consistent with increased globalization over our sample period enhancing countries interdependence.

In Section F of the online appendix, we compare our input-output welfare exposure (U^{IO}) and income exposure (W^{IO}) measures to a number of simpler measures of trading relationships between countries: (i) log value of bilateral trade; (ii) aggregate import shares (the expenditure share matrix from our single-sector model (S^{SSM})); (iii) the expenditure share matrix from our

¹²Around 30 percent of bilateral pairs are enemies, although these negative values for welfare exposure are typically small in absolute magnitude. Enemies are frequently raw materials exporters that compete for markets, such as Chile and South Africa, and Saudi-Arabia and Niger. The absence of direct trade increases the probability that bilateral pairs are enemies, consistent with the cross-substitution effect being particularly strong in this case.

¹³To obtain the percentage change in welfare in response to productivity shocks, one needs to multiply the elasticities in Figures 1 by the size of the productivity shock. When we do so, we obtain predictions for the impact of productivity shocks of similar size to the existing quantitative trade literature, as shown in Section 5.2 below.

Figure 1: Mean and Standard Deviation of Welfare Exposure to Productivity Shocks in Other Countries over Time



Note: Left panel shows mean welfare exposure (black line) and the 95 percent confidence interval (gray shading); right panel shows the standard deviation of welfare exposure (black line); both panels exclude own productivity shocks; NBER World Trade Database and authors' calculations using our input-output specification.

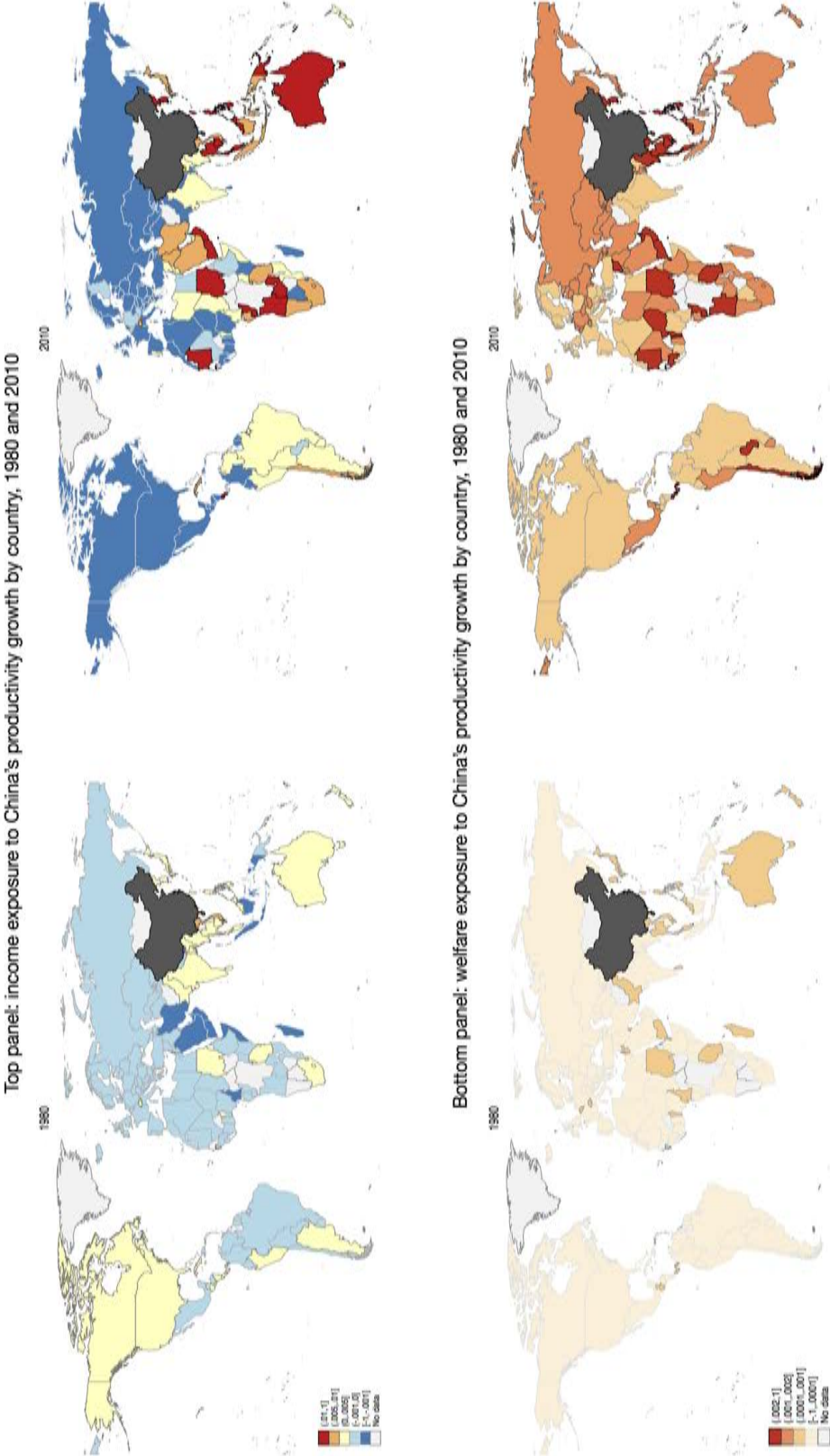
input-output model (S^{IO}); (iv) the income share matrix from our input-output model (T^{IO}); and (v) the cross-substitution matrix from our input-output model (M^{IO}). While our economic exposure measures have statistically significant correlations with all of these variables, we show that they are all imperfect proxies for our theoretically-consistent exposure measures.

China's Emergence into the Global Economy We next examine the impact of China's emergence into the global economy on patterns of income and welfare exposure. Following [Autor et al. \(2013\)](#), a large empirical literature argues that China's rapid economic growth was driven by a supply-side shock from its domestic liberalization in 1978. Therefore, we use this natural experiment as an exogenous source of variation to examine the impact on other countries' income and welfare exposure and their bilateral political alignment.

In Figure 2, we show maps of country exposure to Chinese productivity growth in 1980 (shortly after its market-orientated reforms) and 2010 (close to the end of our sample period). Income and welfare exposure are shown in the top and bottom panels, respectively. To ensure that results for income exposure in the top panel are invariant to our choice of numeraire, we normalize income exposure relative to the income-weighted average for OECD countries. Therefore, positive values represent an increase in income relative to the OECD average (shown in shades of red), and negative values correspond to a decrease in income relative to the OECD average (shown in shades of blue).

In 1980, Chinese productivity growth has modest effects on the relative income of countries

Figure 2: Country Income and Welfare Exposure to Chinese Productivity Growth, 1980 and 2010



Note: income exposure is normalized relative to the income-weighted average of OECD countries; negative values (indicated using shades of blue, with darker shading denoting more negative effects) show decreases in income relative to the OECD average; positive values (indicated using shades of red, with darker shading denoting more positive effects) show increases in income relative to the OECD average. Welfare exposure is invariant to our choice of numeraire; darker shades of red denote more positive values.

Source: NBER World Trade Database and authors' calculations using our input-output specification.

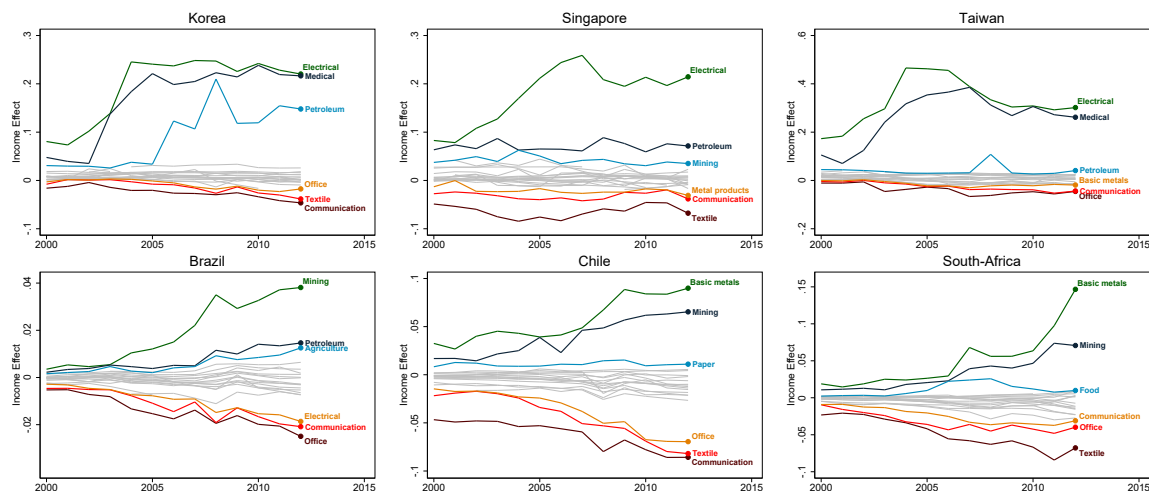
around the globe, with small positive effects on Australia, India, South Africa and the United States, and small negative effects on most of the rest of Africa, Brazil, Western Europe and Russia. With China's rapid economic growth over the course of our sample period, we observe an increase in the absolute magnitude of these income effects and a change in their spatial distribution. By 2010, we find increasingly large negative effects on relative income for industrialized countries, such as the United States and most Western European countries. In contrast, we find increasingly large positive effects on relative income for resource-rich economies, including a number of African countries, as well as Australia and Chile. We also observe increasingly large positive effects on relative income for a cluster of East Asian countries, consistent with the expansion of geographic production chains in Factory Asia.

In the bottom panel, we observe positive welfare effects from Chinese productivity growth for almost all countries, where we use darker shades of red to denote larger values of welfare exposure. This pattern of results highlights the strength of the cost of living effect in the model, and the importance of distinguishing between income and welfare. For resource-rich African countries, as well as Australia and Chile, we find a similar pattern of results for welfare exposure as for income exposure, with increasingly large positive effects over time. Similarly, for East Asian countries, the cost of living effects reinforces our earlier results for relative income exposure, with Chinese productivity growth having increasing large positive effects on the welfare of these countries through geographic production chains.

Sector Income Exposure We now provide further evidence on the mechanisms underlying these aggregate changes in income and welfare exposure. In our multi-sector framework with input-output linkages, even foreign productivity growth that is common across industries can have heterogeneous effects on industry income across countries. These heterogeneous effects depend on the extent to which countries share similar patterns of industry comparative advantage in output markets or source intermediate inputs from one another. We use our linearization to construct analogous measures of *industry* income exposure, which capture these heterogeneous effects across industries, as shown in Section D.6.10 of the online appendix.

In Figure 3, we show the effects of Chinese productivity growth on industry income relative to the income-weighted average of OECD countries for South-East Asian and resource-rich emerging economies. For both the South-East Asian countries and resource-rich emerging economies, we find some of the most negative effects for the Textiles sector. In contrast, we find striking differences between the two groups of countries in the sectors with the most positive income effects. For the South-East Asian countries, the sectors that benefit most from Chinese productivity growth include the Electrical, Medical and Office Equipment sectors, which is consistent with input-output linkages between related sectors through global value chains in Factory Asia.

Figure 3: Industry Income Exposure in South-East Asia and Resource-Rich Emerging Economies to Chinese Productivity Growth (Relative to the Income-Weighted Average of OECD Countries)



Source: NBER World Trade Database and authors' calculations using our input-output specification.

However, for the resource-rich emerging economies, the sectors that benefit most include the Mining, Agricultural and Basic Metals sectors, which is in line with a form of “Dutch Disease,” where the growth of resource-intensive sectors propelled by Chinese demand competes away factors of production from less resource-intensive sectors.

Hub and Authority Scores As our approach recovers the bilateral network of country income and welfare exposure from a single matrix inversion, we can use techniques from the networks literature to characterize the role of countries' positions within the network in shaping the impact of productivity growth. In particular, we use the authority and hub scores from [Kleinberg \(1999\)](#), which capture the extent to which a country affects others (authority score) and the extent to which a country is influenced by others (hub score), as discussed in Section 2.3 above. We compute these hub and authority scores for welfare exposure (U) for each year of our sample period. We set the diagonal entries of U to zero, in order to focus on welfare exposure to foreign productivity growth. We report 5-year moving averages to abstract from short-run fluctuations in international trade flows.

In Table 1, we list the five countries with the highest authority and hub scores for the years 1980 and 2010.¹⁴ Countries with higher authority scores—the productivity growth of which generates the greatest welfare impact to others—tend to be larger, although country-level GDP is only moderately correlated with authority scores, with a correlation coefficient of 0.66. The authority scores spotlight the decline of Japan, the growth of which had more global impact than that of

¹⁴In Section F of the online appendix, we provide further evidence on the evolution of the network of global bilateral welfare exposure over our sample period using network graphs.

the United States in 1980, and the rise of China, which was outside of top-5 in 1980, but had the greatest authority score in 2010. Table 1 also lists the countries that are most exposed to foreign productivity changes. The hub score weakly and negatively correlates (coefficient -0.10) with a country's GDP.

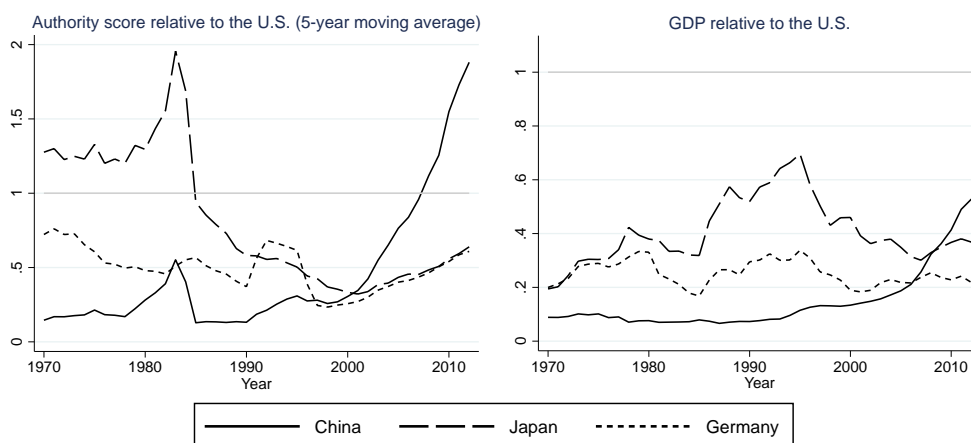
Table 1: Countries with the Highest Welfare Authority and Hub Scores, 1980 and 2010

| Countries with the highest authority scores | | Countries with the highest hub scores | |
|---|------------------|---------------------------------------|--------------|
| 1980 | 2010 | 1980 | 2010 |
| 1. Japan | 1. China | 1. Vietnam | 1. Syria |
| 2. United States | 2. United States | 2. Cambodia | 2. Singapore |
| 3. France | 3. France | 3. Singapore | 3. Djibouti |
| 4. Saudi Arabia | 4. Germany | 4. Belize | 4. Vietnam |
| 5. Singapore | 5. Japan | 5. Lebanon | 5. Malaysia |

Note: Authority and hub scores for welfare exposure computed using equation (17) above in our input-output specification.

Even though correlated with GDP, the authority score has substantial independent variation. We find that countries more integrated into global value chains (including the South-East Asian countries of Singapore, Thailand, Malaysia, Taiwan towards the end of our sample period) tend to have greater authority scores relative to GDP. In contrast, commodity exporters (such as Brazil, Mexico, Chile, and Colombia) tend to have lower authority scores relative to GDP.

Figure 4: Welfare Authority scores and GDP relative to the U.S. for China, Japan, and Germany



Source: NBER World Trade Database and authors' calculations using our input-output specification.

In the left panel of Figure 4, we show the authority score of China, Japan, and Germany relative to that of the U.S. over our sample period. In the right panel, we show the GDP of the same group of countries relative to that of the U.S.. A striking feature is that while the GDPs of Japan and China never exceed 70 percent of the U.S. level between 1970 and 2012, the authority scores of

Japan and China far exceed those of the U.S. in the 1980s and 2010s, respectively. Therefore, these authority scores sharply illustrate the growing dependence of other countries on Chinese productivity growth over the course of our sample period.

4.2 Political Friends and Enemies

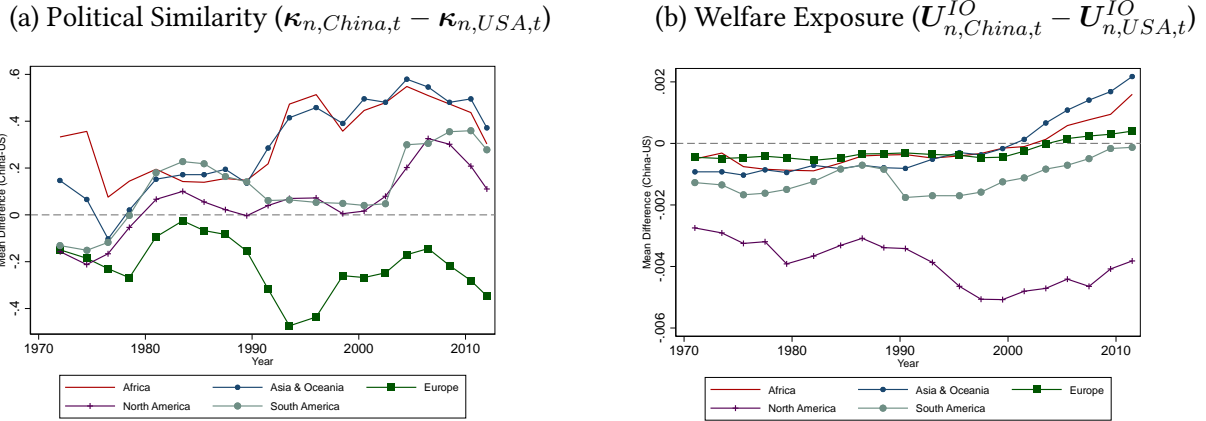
We now show that these changes in economic exposure to Chinese productivity growth are accompanied by a systematic political realignment away from the United States and towards China, which is particularly strong for African and Asian countries.

We begin by constructing a measure of relative political alignment towards China and the United States. In our baseline specification, we use our κ -score measure of the bilateral similarity of countries' voting patterns in the UNGA, which controls for the empirical distribution of yes, no or abstain votes. But we find a similar pattern of results with our other measures. First, for all other countries n and years t , we compute the difference between each country's political alignment to China and its alignment to the United States ($A_{n,China,t}^{\kappa} - A_{n,USA,t}^{\kappa}$). Second, for each year t , we take the average of this relative political alignment across countries within each of the following geographical areas of Africa, Asia/Oceania, Europe and North and South America. In Figure 5a, we display the evolution of this mean relative political alignment over time. Following China's liberalization in 1978, we observe that other countries become more politically aligned towards China relative to the United States. We find that this realignment is stronger for Africa and Asia/Oceania, and weaker for Europe and North and South America.

We next construct an analogous measure of relative economic exposure towards China and the United States. First, for all other countries n and years t , we compute the difference between each country's welfare exposure to China and its welfare exposure to the United States ($U_{n,China,t}^{IO} - U_{n,USA,t}^{IO}$). Second, for each year t , we take the average of this relative welfare exposure across countries within each of the same geographical areas. In Figure 5b, we display the evolution of this mean relative welfare exposure over time. Following China's liberalization in 1978, we observe an increase in other countries' welfare exposure to China relative to the United States. Again we find that this change in the pattern of relative welfare exposure is stronger for Africa and Asia/Oceania, and weaker for Europe and North and South America.¹⁵

¹⁵While we report results for relative political alignment and relative welfare exposure, we also find the same pattern of results without differencing relative to the United States.

Figure 5: Relative Political Alignment and Welfare Exposure by Continent Over Time (Average Towards China Minus Average Towards the United States)

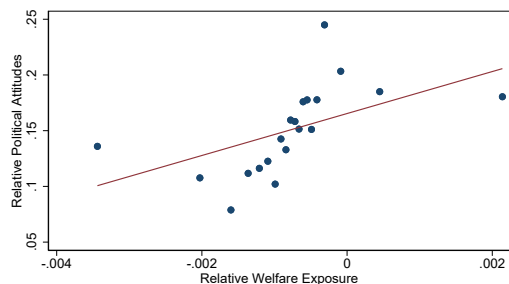


Notes: In the left panel, we first measure the bilateral political alignment of each country n to each country i in each year t using the κ -score measure (κ_{nit}) of the similarity of country votes in the United Nations General Assembly (UNGA); we next compute each country's political alignment to China minus its political alignment to the United States in each year ($A_{n,China,t}^\kappa - A_{n,USA,t}^\kappa$); finally, we take averages of this relative political alignment in each year across all countries within each region (excluding China and the United States); in the right panel, we first measure the welfare exposure of each country n to each country i in each year t (U_{nit}^{IO}) in our input-output specification from equation (16); we next compute each country's welfare exposure to China minus its welfare exposure to the United States in each year ($U_{n,China,t}^{IO} - U_{n,USA,t}^{IO}$); finally, we take averages of this relative welfare exposure in each year across all countries within each region (excluding China and the United States).

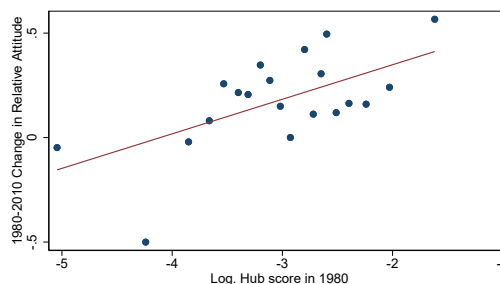
While Figure 5 shows the average relationship for each continent, Figure 6a displays this relationship across individual countries. In particular, we display ventiles from a binscatter of the change in relative political alignment ($A_{n,China,t}^\kappa - A_{n,USA,t}^\kappa$) against the change in relative welfare exposure ($U_{n,China,t}^{IO} - U_{n,USA,t}^{IO}$), after conditioning on country and year fixed effects and each importer's aggregate share of expenditure on each exporter in each year (the expenditure share matrix from the single-sector model (S^{SSM})). The inclusion of these fixed effects implies that this relationship is identified from differential changes in relative political alignment and welfare exposure within countries over time. We also display the corresponding linear fit between the two variables. As shown in the figure, we find a positive and statistically significant relationship, with an estimated coefficient of 18.833 (standard error 2.998). Therefore, individual countries with larger increases in welfare exposure towards China relative to the United States exhibit greater political realignment away from the United States and towards China.

Figure 6: Binscatters of Relative Political Alignment and Relative Welfare Exposure

(a) Changes in Relative Political Alignment and Changes in Relative Welfare Exposure



(b) Changes in Relative Political Alignment and Initial Hub Score



Notes: Left panel shows a binscatter of country relative political alignment against country relative welfare exposure, after conditioning on country and year fixed effects and each importer’s aggregate share of expenditure on each exporter (the expenditure share matrix from the single-sector model (S^{SSM})); relative political alignment equals each other country’s κ -score for China minus its κ -score for the United States in each year ($A_{n,China,t}^{\kappa} - A_{n,USA,t}^{\kappa}$); relative welfare exposure equals each other country’s welfare exposure to China minus its welfare exposure to the United States in each year ($U_{n,China,t}^{IO} - U_{n,USA,t}^{IO}$); the inclusion of country and year fixed effects implies that the figure shows the relationship between changes in relative political alignment and changes in relative welfare exposure; the red line shows the linear fit with coefficient 18.833 (standard error 2.998); each blue dot corresponds to a ventile (twenty quantile) of the country-year distribution; Right panel shows a binscatter of changes in countries’ relative political alignment ($A_{n,China,t}^{\kappa} - A_{n,USA,t}^{\kappa}$) from 1980-2012 against countries’ initial hub score in 1980 as computed from equation (17) in our input-output specification.

In Figure 6b, we provide a further piece of evidence in support of the view that changes in welfare exposure are driving changes in political alignment. We display ventiles from a binscatter of the change in countries’ relative political alignment ($A_{n,China,t}^{\kappa} - A_{n,USA,t}^{\kappa}$) from 1980-2012 against their initial hub scores in 1980 shortly after China’s market-orientated reforms. We find that countries that initially have the highest levels of exposure to productivity growth in *any* nation experience the largest changes in political realignment away from the United States and towards China. We also display the corresponding linear fit, with a positive and statistically significant coefficient of 0.135 (standard error 0.033). This pattern of results is consistent with the idea that these countries with high initial hub scores were the most vulnerable to the change in relative welfare exposure following China’s emergence into the global economy.

4.3 Economic and Political Friends and Enemies

We next provide further evidence on the role of changes in economic exposure in inducing changes in political alignment, using variation across all country-partner pairs from the large-scale decline in the cost of air travel over our sample period.

Time-varying Geographic Instrument The key empirical challenge is that bilateral welfare exposure depends on bilateral trade flows, which in general are endogenous to bilateral political alignment. Therefore, there could be reverse causality from bilateral political alignment to bilat-

eral welfare exposure, or omitted third variables (such as geographical proximity) could affect all three variables of bilateral trade, welfare exposure and political alignment. This empirical challenge is similar to that faced by the literature concerned with the relationship between trade and growth, in which both trade and growth are endogenous. Early attempts to estimate this relationship using exogenous sources of variation in trade exploited instruments based on geography, including [Frankel and Romer \(1999\)](#). However, while geographical variables such as bilateral distance are free of reverse causality, they can still violate exclusion restrictions, because they are correlated with omitted third factors that affect both trade and income. For example, countries close to the equator generally have longer bilateral trade routes and can have low income for other reasons, such as unfavorable disease environments or unproductive colonial institutions, as argued in for example [Acemoglu et al. \(2001\)](#) and [Rodriguez and Rodrik \(2001\)](#).

The problem with these geographical instruments is that they are typically limited to the cross-section, which makes it difficult to control for time-invariant unobserved heterogeneity that can be correlated with the proposed instruments. To overcome this challenge, we follow the recent empirical literature in international trade that has developed time-varying geographic instruments. In particular, we follow [Feyrer \(2019\)](#), in using the large-scale reductions in the cost of air travel that occurred over our sample period as an exogenous source of variation in bilateral trade costs.¹⁶ The key idea underlying this approach is that the position of land masses around the globe generates large differences between bilateral distances by sea and the great circle distances that are more typical of air travel. As a result, countries with long sea routes relative to air routes benefit disproportionately from reductions in the relative cost of air travel, giving rise to uneven changes in bilateral trade costs over time. By using these uneven changes in bilateral trade costs within individual country-partner pairs, we difference out any time-invariant unobserved heterogeneity, such as physical geography and institutions.

Instrumental Variables Specification We now introduce our baseline regression specification connecting political and economic interests. In general, a country’s political alignment towards a trade partner could depend on both the sensitivity (elasticity) of its welfare to productivity growth in that partner and the sign and magnitude of the productivity growth. We use our theoretically-consistent measures of the sensitivity of importer welfare to productivity growth in each exporter (U_{nit}^{IO}) from Proposition 3 above. We control separately for the sign and magnitude of exporter productivity growth using exporter-year fixed effects, exploiting the property that productivity growth is common across trade partners. We also control separately for importer-year fixed effects, which capture importer expenditure and price indexes, and other macro shocks

¹⁶Between 1955 and 2004, the cost of moving goods by air fell by a factor of ten ([Hummels 2007](#)). Before 1960, the air transport share of trade for the United States was negligible. By 2004, air transport accounted for over half of US exports by value, excluding Canada and Mexico ([Feyrer 2019](#)).

that are common across trade partners. In particular, we consider the following second-stage regression specification relating bilateral political alignment (\mathbf{A}_{nit}) to bilateral welfare exposure (\mathbf{U}_{nit}^{IO}) for importer n and exporter i at time t :

$$\mathbf{A}_{nit} = \beta \mathbf{U}_{nit}^{IO} + \vartheta_{ni}^A + \eta_{nt}^A + \mu_{it}^A + \epsilon_{nit}^A, \quad (18)$$

where ϑ_{ni}^A is an importer-exporter fixed effect that captures time-invariant unobserved heterogeneity; η_{nt}^A and μ_{it}^A are importer-year and exporter-year fixed effects; and ϵ_{nit}^A is a stochastic error. We expect countries that benefit more from a partner's productivity growth (more positive or less negative welfare exposure \mathbf{U}_{nit}^{IO}) to be more politically aligned with that partner (higher \mathbf{A}_{nit}). We report standard errors clustered by country-partner pair to allow for serial correlation in the error term over time.

In Column (1) of Table 2, we report the results of estimating this relationship using OLS for our baseline κ -score measure of bilateral political alignment. We find a positive and statistically significant coefficient on welfare exposure (β). Therefore, countries whose welfare is more sensitive to productivity growth in a trade partner are more politically aligned with that trade partner, after controlling for the sign and size of the productivity growth using our exporter-year fixed effects. But the interpretation of this relationship is subject to the concerns discussed above. First, unobserved positive shocks to bilateral political alignment in the error term (ϵ_{nit}^A) could raise bilateral trade and hence raise welfare exposure (\mathbf{U}_{nit}^{IO}), thereby introducing a positive correlation between welfare exposure and the error term, and inducing an upward bias in the estimated coefficient (β). Second, political alignment is likely to be determined by secular forces that are relatively slow moving compared to bilateral trade flows, which are subject to higher-frequency idiosyncratic shocks. These idiosyncratic shocks imply that observed bilateral trade flows need not perfectly capture long-run trade relationships. Therefore, even if these idiosyncratic shocks are independently distributed, they could act like classical measurement error in attenuating the estimated coefficient (β) towards zero.

As a first step to addressing these challenges, we construct an instrument for welfare exposure, which uses its strong correlation with the expenditure share in our input-output model (\mathbf{S}_{nit}^{IO}), and the strong relationship between this expenditure share (\mathbf{S}_{nit}^{IO}) and geography. In particular, we consider the following gravity equation specification:

$$\begin{aligned} \ln \mathbf{S}_{nit}^{IO} = & \gamma_a [\ln (\text{airdist}_{ni}) \times \text{trend}_t] + \gamma_s [\ln (\text{seadist}_{ni}) \times \text{trend}_t] \\ & + \vartheta_{ni}^S + \eta_{nt}^S + \mu_{it}^S + \epsilon_{nit}^S, \end{aligned} \quad (19)$$

where airdist_{ni} is the population-weighted average of the great circle distances between the largest cities within countries; seadist_{ni} is the least-cost path by sea between the leading ports of each country, for all bilateral pairs of countries that are connected by sea; the main effects

of both distance measures and any time-invariant unobserved heterogeneity are captured by the country-partner fixed effect (ϑ_{ni}^S); the interactions of these log distance measures with time trends (trend_t) capture secular changes over time in the relative importance of air and sea distance in determining trade flows with improvements in the technology of air travel; the importer-year (η_{nit}^S) and exporter-year (μ_{it}^S) fixed effects control for changes over time in country income and price indexes and macro shocks; and ϵ_{nit}^S is a stochastic error.

Table 2: Political and Economic Friends

| | (1) | (2) | (3) | (4) | (5) | (6) |
|-------------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| | A_{nit}^κ | A_{nit}^κ | A_{nit}^κ | A_{nit}^κ | A_{nit}^κ | A_{nit}^κ |
| U_{nit}^{IO} | 24.20*** (3.824) | 585.0*** (69.33) | 544.2*** (60.52) | 546.5*** (60.78) | 661.8*** (61.00) | 640.5*** (57.38) |
| Estimation | OLS | IV | IV | IV | IV | IV |
| Observations | 653,214 | 480,452 | 480,452 | 480,452 | 653,214 | 653,214 |
| R-squared | 0.646 | — | — | — | — | — |
| First-stage F-statistic | — | 18.36 | 125.08 | 65.62 | 166.16 | 86.75 |

Note: Panel of exporter-importer-year observations from 1970-2012; all specifications include exporter-importer, exporter-year and importer-year fixed effects; A_{nit}^κ is the κ -score measure of the bilateral similarity of countries' votes in the UNGA; U_{nit}^{IO} is welfare exposure from our input-output specification; Column (2) instruments welfare exposure with the fitted values from the gravity equation (19); Column (3) instruments welfare exposure with the fitted values from the gravity equation (20); Column (4) instruments welfare exposure with interactions between (i) a linear time trend and log sea distance and (ii) a linear time trend and log air distance using equation (21); Column (5) instruments welfare exposure with the interaction between a linear time trend and log air distance; Column (6) instruments welfare exposure with interactions between linear and quadratic time trends and log air distance; the number of observations in Columns (2)-(4) is smaller than in the other columns, because sea distance is missing for country-partner pairs that do not have a sea connection; first-stage F-statistic is a test of the statistical significance of the excluded exogenous variables in the first-stage regression; the second-stage R-squared is not reported for the IV specifications, because it does not have a meaningful interpretation; standard errors in parentheses are clustered by exporter-importer pair; *** denotes significance at the 1 percent level; ** denotes significance at the 5 percent level; * denotes significance at the 10 percent level.

Our first instrument uses the fitted values (\hat{S}_{nit}^{IO}) from the gravity equation (19) to instrument welfare exposure, in order to abstract from the impact of idiosyncratic shocks to bilateral trade (ϵ_{nit}^S). We begin by replicating Feyrer (2019) and estimating the log linear gravity equation (19) for the aggregate value of bilateral trade (X_{nit}) using OLS. We find a positive and statistically significant coefficient on the interaction between log sea distance and the time trend (sea distance becomes less important in determining bilateral trade over time), and a negative and statistically significant coefficient on the interaction between log air distance and the time trend (air distance becomes more important in determining bilateral trade over time).¹⁷

We next estimate the gravity equation (19) for the input-output expenditure share (S_{nit}^{IO}) using

¹⁷We find estimated coefficients (standard errors) of -0.0165 (0.0027) for the interaction between log air distance and the time trend and 0.0051 (0.0026) for the interaction between log sea distance and the time trend.

the Poisson Pseudo-Maximum Likelihood (PPML) estimator of Santos Silva and Tenreyro (2006), which allows for zero bilateral trade flows. Using the estimated parameters, we generate fitted values for the expenditure share (\widehat{S}_{nit}^{IO}), and use these fitted values as our instrument for welfare exposure (U_{nit}^{IO}) in the second-stage regression (18). As reported in Column (2) of Table 2, we continue to find a positive and statistically significant coefficient on welfare exposure (β), which increases in magnitude relative to Column (1).

This increase in the estimated coefficient from Columns (1) to (2) is consistent with the attenuation bias from idiosyncratic shocks to bilateral trade dominating the upward simultaneity bias from a positive correlation between shocks to bilateral political alignment and trade in Column (1). Once we eliminate the impact of these idiosyncratic shocks by instrumenting welfare exposure with the fitted values from the gravity equation (19), the estimated coefficient on welfare exposure increases. As reported at the bottom of Column (2), we find that the fitted expenditure shares (\widehat{S}_{nit}^{IO}) are a powerful instrument for welfare exposure, with a first-stage F-statistic above the conventional threshold of 10.

Although our first instrument addresses this concern about idiosyncratic shocks to bilateral trade, other challenges remain. First, the fitted values for the expenditure share (\widehat{S}_{nit}^{IO}) from the gravity equation (19) include the time-varying exporter-year and importer-year fixed effects. In principle, shocks to political alignment could affect these exporter-year and importer-year fixed effects, which capture endogenous variables such as expenditure and price indexes. Although our second-stage equation for bilateral political alignment (18) also includes exporter-year and importer-year fixed effects, these do not perfectly control for these variables from the gravity equation (19), because the second-stage equation (18) is linear, whereas the gravity equation (19) is log linear. To address this concern, we re-estimate the gravity equation for the expenditure share (S_{nit}^{IO}) using the following specification that is linear in the fixed effects:

$$S_{nit}^{IO} = \gamma_a [\ln(\text{airdist}_{ni}) \times \text{trend}_t] + \gamma_s [\ln(\text{seadist}_{ni}) \times \text{trend}_t] + \vartheta_{ni}^S + \eta_{nt}^S + \mu_{it}^S + \epsilon_{nit}^S, \quad (20)$$

where all variables are defined in the same way as above. Again we use the fitted values from the gravity equation estimation (\widehat{S}_{nit}^{IO}) to instrument welfare exposure. As reported in Column (3) of Table 2, we continue to find a positive and statistically significant coefficient on welfare exposure (β), which is of around the same magnitude as in Column (2). We find that the fitted expenditure shares (\widehat{S}_{nit}^{IO}) remain a powerful instrument for welfare exposure, as shown by the first-stage F-statistic reported at the bottom of Column (3).

Second, the conventional two-stage least squares standard errors in Columns (2) and (3) do not take into account that our instrument for welfare exposure (\widehat{S}_{nit}^{IO}) is itself generated in a prior regression (Pagan 1984). To address this concern, we consider the following first-stage regression

specification in which we directly instrument welfare exposure:

$$\begin{aligned} U_{nit}^{IO} = & \gamma_a [\ln(\text{airdist}_{ni}) \times \text{trend}_t] + \gamma_s [\ln(\text{seadist}_{ni}) \times \text{trend}_t] \\ & + \vartheta_{ni}^U + \eta_{nt}^U + \mu_{it}^U + \epsilon_{nit}^U, \end{aligned} \quad (21)$$

where all variables are defined in the same way as above.

Both the first and second-stage regressions (equations (21) and (18), respectively) include country-partner, exporter-year and importer-year fixed effects. Therefore, this specification controls for time-invariant unobserved heterogeneity, and time-varying shocks that are common across trade partners for each exporter and importer. The coefficient of interest (β) is identified solely from differential changes in bilateral trade costs over time for country-partner pairs with different values for air and sea distance. As reported in Column (4) of Table 2, we continue to find a positive and statistically significant coefficient on welfare exposure (β), which is of around the same magnitude as in Columns (2)-(3). We find that the interactions between air and sea distance and the time trends are powerful instruments for welfare exposure, with a first-stage F-Statistic above the conventional threshold of 10, as reported at the bottom of the column.

Finally, we report a number of further specification checks. First, sea distance is missing for country-partner pairs without a sea connection. Therefore, we consider a specification in which we drop the sea distance interaction, which substantially increases the number of observations. In this specification, the interaction between air distance and the time trend is our sole instrument, and captures the net impact of changes in the technology for air travel on bilateral trade costs at long versus short distances between countries. As reported in Column (5) of Table 2, we continue to find a positive and statistically significant coefficient on welfare exposure (β), which increases somewhat relative to Columns (2)-(4). We find a larger first-stage F-statistic in this more parsimonious specification with a single instrument, as shown at the bottom of the column.

Second, we explored allowing for richer functional forms for the change in bilateral trade costs at long versus short distances between countries. We augmented our interaction between a linear trend and log air distance in the first-stage regression from Column (5) with an interaction between a quadratic trend and log air distance. As reported in Column (6) of Table 2, we find a similar estimated coefficient on welfare exposure (β), which suggests that there is little additional information in this higher-order term, consistent with our estimates capturing a secular improvement in transportation technology over time. The first-stage F-statistic falls somewhat when we add this higher-order interaction, but remains above the conventional threshold of 10. As a further robustness check, we replaced our interaction between a linear trend and log air distance in Column (5) with (i) interactions between year dummies and log air distance; (ii) interactions between five-year period dummies and log air distance; (iii) interactions between ten-year period dummies and log air distance. Across all of these specifications, we find a similar positive and sta-

tistically significant coefficient on welfare exposure (β).¹⁸ We use the linear trend interacted with log air distance as our baseline specification, in order to focus on differences in secular trends in bilateral trade costs between long and short bilateral distances.

Taken together, the results of this section provide evidence that secular increases in bilateral welfare exposure predicted by our instrument induce increased bilateral political alignment between countries as captured by the κ -score measure of voting similarity in the UNGA. In the remainder of this section, we show that the same pattern holds across a wide range of measures of political similarity, including measures of the bilateral distance in foreign policy ideal points, strategic rivalries, and formal alliances. For each of these measures of bilateral political alignment, we demonstrate the robustness of our results across a wide range of different specifications.

Alternative Measures of Voting Similarity in the UNGA In our empirical results above, we focused on the κ -score as our baseline measure of the bilateral similarity of countries' UNGA voting, because it controls for the empirical frequency with which each country votes yes, no or abstain. Nevertheless, we now show in Table 3 that we find the same pattern of results using other measures of bilateral political alignment based on the UNGA voting data.

In the top panel, we report the results of estimating equation (18) using OLS. In the bottom panel, we report the results of estimating the same specification using two-stage least squares, instrumenting welfare exposure with our interaction between a linear trend and log air distance. In Column (1) of the top and bottom panels, we reproduce our baseline results using the κ -score (from Columns (1) and (5) of Table 2). In Columns (2) and (3) of Table 3, we estimate the same specification using the S -score and π -score measures of bilateral political alignment, respectively. Again we find that increases in bilateral welfare exposure raise bilateral political alignment between countries. In Column (4), we estimate the same specification using our measure of the difference in countries' ideal points based on the UNGA voting data. Consistent with the previous columns, we find that increases in bilateral welfare exposure reduce the bilateral distance between countries' foreign policy ideal points. Again our instrument has power in the first-stage regressions, with first-stage F statistics above the conventional threshold of 10 in all columns.

¹⁸For example, using interactions between five-year period dummies and log air distance, we find an estimated coefficient (standard error) on welfare exposure of 594.56 (49.24).

Table 3: Political and Economic Friends (Alternative Measures of Bilateral Political Alignment)

| Panel A: OLS | | | | | | | | |
|---------------------|---------------------|---------------------|---------------------|----------------------|----------------------|----------------------|----------------------|-----------------------|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| | A_{nit}^{κ} | A_{nit}^S | A_{nit}^{π} | A_{nit}^{ideal} | A_{nit}^{κ} | A_{nit}^S | A_{nit}^{π} | A_{nit}^{ideal} |
| U_{nit}^{IO} | 24.20*** (3.824) | 12.01*** (2.099) | 25.77*** (4.085) | -28.59*** (8.524) | 23.49*** (4.553) | 11.15*** (2.451) | 24.45*** (4.879) | -27.45*** (9.611) |
| S_{nit}^{SSM} | | | | | 0.0628 (0.274) | 0.0760 (0.133) | 0.118 (0.295) | -0.104 (0.466) |
| N | 653,214 | 653,214 | 653,214 | 623,586 | 653,214 | 653,214 | 653,214 | 623,586 |
| r2 | 0.646 | 0.872 | 0.709 | 0.833 | 0.646 | 0.872 | 0.709 | 0.833 |
| Panel B: IV | | | | | | | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| | A_{nit}^{κ} | A_{nit}^S | A_{nit}^{π} | A_{nit}^{ideal} | A_{nit}^{κ} | A_{nit}^S | A_{nit}^{π} | A_{nit}^{ideal} |
| U_{nit}^{IO} | 661.8*** (61.00) | 353.2*** (32.98) | 701.7*** (65.27) | -652.4*** (104.1) | 1699.4*** (332.0) | 908.0*** (178.6) | 1800.8*** (352.7) | -1699.4*** (419.3) |
| S_{nit}^{SSM} | | | | | -83.47*** (22.18) | -44.63*** (11.92) | -88.43*** (23.54) | 83.87*** (25.76) |
| N | 653,214 | 653,214 | 653,214 | 623,586 | 653,214 | 653,214 | 653,214 | 623,586 |
| First-stage F | 166.2 | 166.2 | 166.2 | 140.7 | 27.47 | 27.47 | 27.47 | 23.34 |

Note: Panel of exporter-importer-year observations from 1970-2012; all specifications include exporter-importer, exporter-year and importer-year fixed effects; Column (1) of Panel A corresponds to Column (1) of Table 2; Column (1) of Panel B corresponds to Column (5) of Table 2; A_{nit}^{κ} , A_{nit}^S and A_{nit}^{π} are the κ -score, S -score and π -score measures of the bilateral similarity of countries' votes in the UNGA, respectively; A_{nit}^{ideal} is the bilateral difference in countries' ideal points from the UNGA voting data; U_{nit}^{IO} is welfare exposure from our input-output specification; S_{nit}^{SSM} is the share of each exporter in the aggregate expenditure of each importer (the expenditure share in the single-sector model); Panel A reports OLS estimates; Panel B reports IV estimates, in which welfare exposure is instrumented with the interaction between a linear time trend and log air distance; first-stage F-statistic is a test of the statistical significance of the excluded exogenous variables in the first-stage regression; the second-stage R-squared is not reported for these IV specifications, because it does not have a meaningful interpretation; standard errors in parentheses are clustered by exporter-importer pair; *** denotes significance at the 1 percent level; ** denotes significance at the 5 percent level; * denotes significance at the 10 percent level.

In Columns (5)-(8), we show that our measure of welfare exposure is not simply proxying for bilateral trade between countries. When we augment our regression specification with the aggregate share of importer expenditure on each exporter (S_{nit}^{SSM}), we continue to find the same pattern of results for welfare exposure.¹⁹ In the OLS specification in the top panel, the estimated coefficient on welfare exposure remains of a similar magnitude, while that on the aggregate import share is statistically insignificant. In the IV specification in the bottom panel, the estimated coefficient on welfare exposure remains of the same sign and increases in absolute magnitude. In contrast, the estimated coefficient on the aggregate import share has the opposite sign and

¹⁹We find a similar pattern of results if we instead include the log value of aggregate bilateral trade as a control.

is statistically significant, which likely reflects the fact that the aggregate import share itself is endogenous. Regardless of this endogeneity, we find that our estimates for welfare exposure are not simply capturing bilateral trade between countries, which is consistent with the discussion in Section 4.1, where we noted that our exposure measures are not completely captured by simpler measures of trading relationships between countries.

Alternative Measures of Bilateral Political Alignment While we have so far considered measures of bilateral political alignment based on UNGA voting data, we now demonstrate the robustness of our results to the use of alternative measures of bilateral political alignment.

In Table 4, we estimate the same regression specification (18) using our measures of strategic rivalry, which capture the contemporary perceptions of policy-makers as to whether two countries regard each other as competitors, sources of threats or enemies. Columns (1)-(4) present the OLS estimates, while Columns (5)-(8) contain the IV estimates. Whether we consider all strategic rivalries (Columns (1) and (5)), positional strategic rivalries (Columns (2) and (6)), spatial strategic rivalries (Columns (3) and (7)) or ideological strategic rivalries (Columns (4) and (8)), we find the same pattern of results. In all cases, we find a negative and statistically significant relationship between the propensity with which countries are strategic rivals and bilateral welfare exposure. Consistent with the UNGA voting results, when we instrument bilateral welfare exposure with our interaction between a linear trend and bilateral distance, we find an even stronger relationship, with an increase in the absolute magnitude of the estimated coefficient. Again we find that our instrument has power in the first-stage regression, as indicated by the first-stage F-statistic.

Table 4: Political and Economic Friends (Strategic Rivalries Specification)

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|----------------|----------------------|----------------------|----------------------|---------------------|----------------------|----------------------|----------------------|----------------------|
| | A_{nit}^{Any} | A_{nit}^{Pos} | A_{nit}^{Spa} | A_{nit}^{Id} | A_{nit}^{Any} | A_{nit}^{Pos} | A_{nit}^{Spa} | A_{nit}^{Id} |
| U_{nit}^{IO} | -3.234*** (1.100) | -0.851*** (0.325) | -1.191*** (0.446) | -1.912** (0.975) | -104.5*** (22.72) | -50.50*** (14.31) | -71.91*** (18.17) | -52.30*** (14.63) |
| Estimation | OLS | OLS | OLS | OLS | IV | IV | IV | IV |
| N | 788,396 | 788,396 | 788,396 | 788,396 | 779,664 | 779,664 | 779,664 | 779,664 |
| R-squared | 0.791 | 0.837 | 0.807 | 0.729 | — | — | — | — |
| First-stage F | — | — | — | — | 164.2 | 164.2 | 164.2 | 164.2 |

Note: Panel of exporter-importer-year observations from 1970-2012; all specifications include exporter-importer, exporter-year and importer-year fixed effects; A_{nit}^{Any} , A_{nit}^{Pos} and A_{nit}^{Spa} and A_{nit}^{Id} are indicator variables for any, positional, spatial and ideological strategic rivalries, respectively; U_{nit}^{IO} is welfare exposure from our input-output specification; Columns (1)-(4) report OLS estimates; Columns (5)-(8) report IV estimates, in which welfare exposure is instrumented with the interaction between a linear time trend and log air distance; first-stage F-statistic is a test of the statistical significance of the excluded exogenous variables in the first-stage regression; the second-stage R-squared is not reported for the IV specifications, because it does not have a meaningful interpretation; standard errors in parentheses are clustered by exporter-importer pair; *** denotes significance at the 1 percent level; ** denotes significance at the 5 percent level; * denotes significance at the 10 percent level.

In Table 5, we re-estimate this regression specification (18) using our measures of formal alliances between countries. The top panel reports the OLS estimates, while the bottom panel gives the IV estimates. We find the same pattern of results for any alliances (Column (1)), mutual defense pacts (Column (2)), non-aggression treaties (Column (4)) and ententes (Column (5)). Consistent with the UNGA voting results, we find a positive and statistically significant relationship between the frequency with which countries form alliances and bilateral welfare exposure. When we instrument bilateral welfare exposure with our interaction between a linear trend and bilateral distance, we again find that this relationship strengthens, with an increase in the absolute magnitude of the estimated coefficient. The only exception is for neutrality pacts, where the estimated coefficient is statistically insignificant in the OLS specification, but becomes positive and statistically significant in the IV specification. This pattern of results could reflect the fact that neutrality decisions are more tied to multilateral considerations (with all of a country's neighbors) rather than bilateral considerations (with one of a country's neighbors). Again we find that our instrument has power in the first-stage regression, as shown by the first-stage F-statistic.

Table 5: Political and Economic Friends (Formal Alliances Specification)

| Panel A: OLS | | | | | |
|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| | (1) | (2) | (3) | (4) | (5) |
| | A_{nit}^{AllAny} | A_{nit}^{AllDef} | A_{nit}^{AllNeu} | A_{nit}^{AllNon} | A_{nit}^{AllEnt} |
| U_{nit}^{IO} | 4.518*** (1.200) | 2.994** (1.257) | 0.986 (0.969) | 3.734*** (1.448) | 3.949*** (1.147) |
| N | 788,396 | 788,396 | 788,396 | 788,396 | 788,396 |
| R-squared | 0.899 | 0.902 | 0.564 | 0.897 | 0.908 |
| Panel B: IV | | | | | |
| | (1) | (2) | (3) | (4) | (5) |
| | A_{nit}^{AllAny} | A_{nit}^{AllDef} | A_{nit}^{AllNeu} | A_{nit}^{AllNon} | A_{nit}^{AllEnt} |
| U_{nit}^{IO} | 803.0*** (74.43) | 798.0*** (73.30) | 35.98*** (12.38) | 603.3*** (60.20) | 550.7*** (54.30) |
| N | 779,664 | 779,664 | 779,664 | 779,664 | 779,664 |
| First-stage F | 164.2 | 164.2 | 164.2 | 164.2 | 164.2 |

Note: Panel of exporter-importer-year observations from 1970-2012; all specifications include exporter-importer, exporter-year and importer-year fixed effects; A_{nit}^{AllAny} , A_{nit}^{AllDef} , A_{nit}^{AllNeu} , A_{nit}^{AllNon} , and A_{nit}^{AllEnt} are indicator variables for any, defense, neutrality, non-aggression and entente formal alliances, respectively; U_{nit}^{IO} is welfare exposure from our input-output specification; Panel A reports OLS estimates; Panel B reports IV estimates, in which welfare exposure is instrumented with the interaction between a linear time trend and log air distance; first-stage F-statistic is a test of the statistical significance of the excluded exogenous variables in the first-stage regression; the second-stage R-squared is not reported for the IV specifications, because it does not have a meaningful interpretation; standard errors in parentheses are clustered by exporter-importer pair; *** denotes significance at the 1 percent level; ** denotes significance at the 5 percent level; * denotes significance at the 10 percent level.

Long-Differences Specification In our empirical results so far, we have used an exporter-importer-year panel, which allows us to include exporter-importer fixed effects to control for time-invariant unobserved heterogeneity, and exporter-year and importer-year fixed effects to control for the sign and magnitude of productivity growth and time-varying factors that are common across trade partners for each exporter and importer. Although this panel data specification focuses on changes in bilateral political alignment and welfare exposure within country-partner pairs, it uses deviations each year from the country-partner time mean, and one concern could be that bilateral political alignment changes over longer-time horizons. Our IV specification addresses this concern, by using an interaction between a linear trend and distance as our instrument, which implies that we exploit variation from differences in linear trends within country-partner pairs between long versus short bilateral distances. As a further robustness check to address this concern, Section G of the online appendix reports a long-differences specification using five-year differences. In this specification, we difference out the exporter-importer fixed effects, and again include exporter-year and importer-year fixed effects to control for the sign and magnitude of productivity growth and time-varying factors that are common across trade partners for each exporter and importer. Again in both our OLS and IV estimates, we find that increases in bilateral welfare exposure raise bilateral political alignment, confirming the results of our baseline panel data specification here.

Summary As a country becomes more economically exposed to productivity growth in a trade partner, we find that it becomes more politically aligned with that trade partner. We find this pattern of results using quite different approaches to measuring political alignment: (i) United Nations voting data; (ii) the perceptions of contemporary policy-makers about strategic rivalries; and (iii) formal alliances between nations. We find this relationship after controlling for unobserved time-invariant heterogeneity that is specific to each country-partner pair (e.g. geographical location and institutions) and time-varying factors that are specific to each exporter and importer and common across trade partners. Our estimates therefore focus on changes in bilateral political alignment and bilateral welfare exposure within individual country-partner pairs. We demonstrate that this relationship holds whether we use all of the observed variation in bilateral welfare exposure (in our OLS specification) or the differential changes in welfare exposure between long and short bilateral distances because of improvements in the technology of air travel (in our IV specification). Therefore, whether we consider China's emergence into the global economy as a natural experiment (previous section) or exogenous variation from the improvement in the technology of air travel (this section), we find that increases in economic friendship lead to increases in political friendship between countries.

5 Specification Checks

In this section, we report additional specification checks on our economic exposure measures. In Subsection 5.1, we report an overidentification check on these measures, in which we show that they are systematically related to separate data on preferential trade agreements (PTAs) that were not used in their estimation. In Subsection 5.2, we examine the concern that our economic exposure measures are based on a linearization that in theory is only exact for small changes, and in principle there could be important non-linearities. We show that in practice our exposure measures closely approximate the full non-linear model solution even for large shocks, including the cumulative changes in productivity over our sample period of more than forty years.

5.1 Preferential Trade Agreements (PTAs)

We use separate data on PTAs to provide an overidentification check on our economic exposure measures. We first examine the determinants of PTAs: If our exposure measures correctly capture gains from economic integration, we would expect them to predict self-selection into PTAs. We next examine the effects of PTAs: If our exposure measures correctly capture economic interdependence between countries, we would expect to observe systematic changes in these measures following the formation of PTAs.

In Section H.1.1 of the online appendix, we estimate a selection model for the decision to form a PTA. We show that initial income and welfare exposure to reductions in bilateral trade costs in 1970 are predictive of the subsequent formation of PTAs from 1971-2012. We show that this result is robust to controlling for simpler measures of trading relationships between countries, such as initial bilateral trade or aggregate expenditure shares in 1970, or geographical distance. In Section H.1.2 of the online appendix, we use an event-study specification to provide evidence on the effects of PTAs. We show that our exposure measures successfully detect increases in economic interdependence between member countries following the formation of PTAs. We find this pattern of results whether we use exposure to productivity growth or bilateral trade cost reductions, and after controlling for simpler measures of trading relationships between countries. We demonstrate that these results hold across a range of different event-study specifications, including those that allow for variable timing of the treatment and treatment heterogeneity.

Therefore, we find that our exposure measures have predictive power for separate data on PTAs not used in their estimation, both in terms of predicting selection into future PTAs, and in terms of detecting the impact of these future PTAs in increasing economic interdependence between countries.

5.2 Non-linearities

In Section 2, we derived our measures of the sensitivity of country income and welfare to foreign productivity growth from a linearization of the class of international trade models with a constant trade elasticity. Although these exposure measures are exact for small changes, there could be important non-linearities, which could limit their informativeness for large changes. To examine the role of such non-linearities, we now compare the performance of our linearization to the full non-linear model solution for the cumulative changes in productivity growth over our more than forty-year sample period. To build intuition, we first compare the two approaches in our baseline single-sector model, before implementing this comparison for our quantitative specification with multiple sectors and input-output linkages. We focus largely on the quality of our approximation to the full non-linear model solution for productivity shocks that are the subject of our empirical application. For completeness, we also report some results comparing the quality of our approximation for trade cost shocks.

5.2.1 Single-Sector Model

In Section H.2.1 of the online appendix, we show that the difference between the predictions of our linearization and the full non-linear model solution for the impact of productivity shocks corresponds to the difference between the log of a weighted mean and a weighted mean of logs. This difference corresponds to the second and higher-order terms in a Taylor-series expansion around the initial equilibrium. We show that this difference is necessarily equal to zero in the two limiting cases of autarky ($t_{nn} \rightarrow 1$ and $s_{nn} \rightarrow 1$ for all n) and free trade ($t_{in} \rightarrow \bar{t}_i$ and $s_{ni} \rightarrow \bar{s}_i$ for all n, i). More generally, we derive analytical bounds for the magnitude of this approximation error. Given the observed trade matrices and a central value for the trade elasticity of $\theta = 5$, we show that the global approximation errors for the absolute magnitude of the second and higher-order terms are less than 0.62 percent of the variance of productivity shocks for income exposure, and less than 0.33 percent of the variance of productivity shocks for welfare exposure.

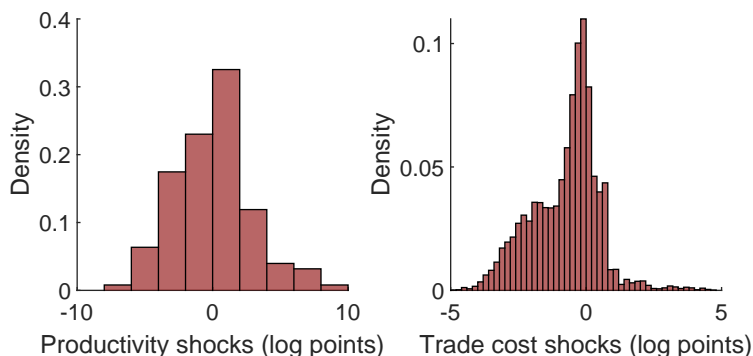
5.2.2 Multiple Sectors and Input-Output Linkages

We now implement this comparison of our linearization and the full non-linear model solution for our quantitative specification with multiple sectors and input-output linkages.

Empirical Distributions of Productivity and Trade Cost Shocks We begin by recovering empirical distributions of productivity and trade cost shocks that we use to compare the predictions of the two approaches. Since we undertake counterfactuals for productivity and trade cost shocks that are common across sectors, we recover these empirical distributions of shocks from

our single-sector model, as discussed in Section H.2.4 of the online appendix. In Figure 7, we display histograms of the resulting log changes in relative productivity (left panel) and trade costs (right panel) for our sample period as a whole, based on our central value of the trade elasticity of $\theta = 5$. We normalize both variables to have a mean of zero in logs. The distribution of productivity shocks is across countries, while the distribution of trade cost shocks is across country-partner pairs. Over this period of more than forty years, which includes double-digit annual growth for some countries such as China, we find large changes in both relative productivity and trade costs. Relative changes in productivity span close to 20 log points (from -9 to 10 log points), while relative changes in trade costs span 10 log points (from -5 to 5 log points). Therefore, although we could undertake our counterfactuals below using any distributions of productivity and trade cost shocks, these empirical distributions provide ample variation to examine the importance of non-linearities.

Figure 7: Empirical Distributions of Productivity and Trade Cost Shocks from 1970-2012

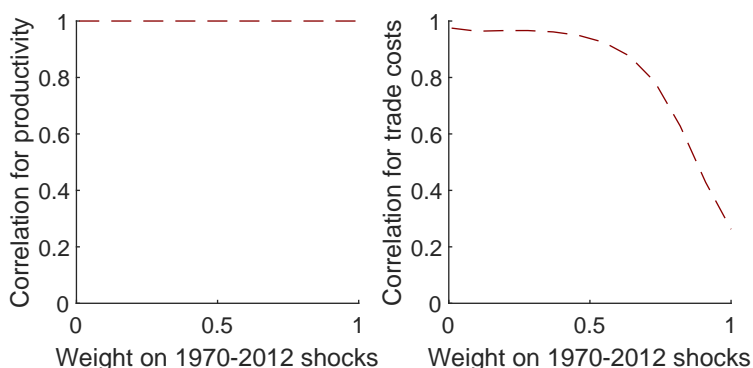


Note: Empirical distributions (histograms) of log productivity shocks (left panel) and log trade cost shocks (right panel) from 1970-2012; productivity and trade cost shocks recovered from inverting the single-sector model, as shown in Section H.2.4 of the online appendix. Both log productivity and trade costs shocks are normalized to have a mean of zero, so that the figure shows shocks to relative productivity and relative trade costs.

Productivity and Trade Cost Shocks We use these empirical distributions of productivity and trade cost shock to undertake counterfactuals in our quantitative specification with multiple sectors and input-output linkages. We compare the predictions of conventional exact-hat algebra counterfactuals in the non-linear model to the predictions of our linearization, as derived for productivity shocks in Proposition 3, and for trade costs shocks in Section D.6.12 of the online appendix. We begin by undertaking this comparison for our central value of the trade elasticity of $\theta = 5$. We vary the magnitude of the productivity shocks by taking weighted averages of the vector of empirical shocks from 1970-2012 in Figure 7 and a vector of ones that corresponds to no shocks ($\hat{z}_i = z'_i/z_i = 1$). Similarly, we vary the magnitude of the trade cost shocks by taking weighted averages of the matrix of empirical shocks from 1970-2012 in Figure 7 and the

identity matrix that again corresponds to no shocks ($\hat{\tau}_{ni} = \tau'_{ni}/\tau_{ni} = 1$). As we vary the weights on the empirical shocks from zero to one, we smoothly vary the magnitude of productivity and trade cost shocks from no shocks to the full empirical magnitude of the shocks. For each size of productivity and trade cost shocks, we compute the correlation coefficient across countries between the log counterfactual changes in welfare predicted by the non-linear model and those predicted by our linearization.

Figure 8: Correlations Between the Non-Linear and Linear Counterfactual Predictions for Log Changes in Welfare for Different Magnitudes of the Productivity and Trade Cost Shocks



Note: Left panel shows results for productivity shocks and right panel shows results for trade cost shocks using the empirical distributions of these shocks from Figure 7 above; vertical axis shows the correlation across countries between the non-linear and linear counterfactual predictions for log changes in welfare; horizontal axis varies the magnitude of the shocks by varying the weights on the empirical shocks (α) and no shocks ($1 - \alpha$) from zero to one, where no shocks corresponds to $z'_i/z_i = 1$ and $\tau'_{ni}/\tau_{ni} = 1$. Therefore, a value of zero on the horizontal axis corresponds to no shocks, while a value of the one on the horizontal axis corresponds to the full empirical value of shocks from 1970-2012 from Figure 7 above.

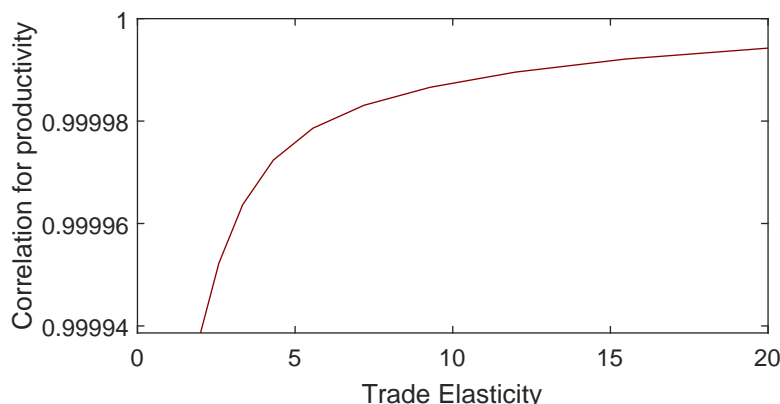
In Figure 8, we display these correlations between the welfare predictions of the non-linear model and our linearization (vertical axis) against the weight on the empirical shocks (horizontal axis). The left and right panels show these correlations for productivity and trade cost shocks, respectively. Larger weights on the empirical shocks on the horizontal axis correspond to bigger shocks. Regardless of the magnitude of the productivity shocks that we consider, we find a correlation in the left panel that is visibly indistinguishable from one, at least up to the (large) empirical value of the shocks from Figure 7 above. For trade cost shocks up to around half as large as the empirical shocks, we also find a correlation close to one in the right panel. As we increase the magnitude of the trade cost shocks towards the (large) empirical value of the shocks, we find that the correlation begins to fall, but it remains above 0.5 for most of the interval, and is always positive and statistically significant at conventional levels.²⁰ Even for large trade cost

²⁰Whereas productivity shocks are common across all trade partners, trade shocks are bilateral, which results in a three-tensor rather than a matrix representation (see Section D.1 of the online appendix). Our friend-enemy

shocks for which the correlation falls, we find that this decline is driven by a few countries, and that for most countries the linear and non-linear predictions for the log changes in welfare are close, as shown in Section H.2.6 on the online appendix.

Robustness to Alternative Trade Elasticities ($\theta \in [2, 20]$) So far, we have established a strong correlation between the linear and non-linear predictions for the productivity shocks that are the subject of our empirical application using a central trade elasticity of $\theta = 5$. We now demonstrate the robustness this result to the assumption of alternative values for the trade elasticity from 2 to 20, which spans the empirically-relevant range.²¹ We use the full empirical magnitude of productivity shocks at the right-most point on the horizontal axis in Figure 8 with a weight of one. We hold the empirical distribution of productivity shocks constant and compute the correlation between the linear and non-linear predictions for log changes in welfare in response to these productivity shocks for alternative values of the trade elasticity. Across the entire of this empirically-relevant range of trade elasticities, we find a correlation close to one. As we increase the trade elasticity, the correlation between the linear and non-linear predictions increases, because for larger trade elasticities smaller changes in the endogenous variables are required to restore equilibrium in the model in response to the productivity shocks.

Figure 9: Correlations Between the Non-Linear and Linear Counterfactual Predictions for Log Changes in Welfare in Response to Productivity Shocks for Trade Elasticities from 2 to 20



Note: Vertical axis shows the correlation across countries between the linear and non-linear counterfactual predictions for log changes in welfare in response to the full empirical magnitude of productivity shocks from 1970-2012 from Figure 7 above; horizontal axis shows the trade elasticity (θ).

representation reduces this three-tensor down to a matrix using the observed trade shares, which contributes to the lower correlation between the non-linear and linear predictions for large changes in trade costs.

²¹Eaton and Kortum (2002) reports estimates of the trade elasticity ranging from 2 to 12; Costinot and Rodríguez-Clare (2014) assumes a central value of 5; and Simonovska and Waugh (2014) estimates a value of 4.

Summary Although in theory our sensitivity measures are only exact for small changes, and in principle there could be important non-linearities, we find that in practice the role for these non-linearities is limited. For the sensitivity of country welfare to productivity shocks that is the subject of our empirical application, we find correlations between the counterfactual predictions of the non-linear model and our linearization that are close to one throughout the empirically-relevant range of values for the trade elasticity from 2 to 20, even when we consider productivity shocks equal to the cumulative change in relative productivity over our more than forty-year sample period. Therefore, our measures of the sensitivity of country welfare to foreign productivity growth are not only exact for small shocks, but are close to exact for empirically-reasonable productivity shocks and trade elasticities.

6 Conclusions

To what extent do nations' economic interests influence their political behavior? We provide new theory and evidence on this question by developing model-consistent measures of the sensitivity of welfare in one country with respect to productivity growth in another country. We derive these measures from first-order general equilibrium comparative statics in the class of international trade models with a constant trade elasticity. We introduce a bilateral friend-enemy representation of these comparative statics, where one country is a friend [enemy] for income or welfare in another country if its productivity growth raises [reduces] the income or welfare of the other country.

Our new economic exposure measures have a number of advantages for studying the relationship between economic and political interests. First, they correspond exactly to the *sensitivity* of country welfare with respect to foreign productivity growth in the class of constant elasticity trade models. Second, they use only data on observed trade flows, without requiring us to measure actual shocks or predict counterfactual shocks. Third, since our measures are derived from a linearization of the general equilibrium conditions in this class of models, they capture all (first-order) general equilibrium effects. Fourth, we recover the entire bilateral network of country income and welfare exposure to productivity growth from a single matrix inversion, which allows us to use techniques from the networks literature to characterize the role of countries' positions in the network in influencing the effects of productivity growth. Finally, although our sensitivity measures are based on a linearization, and thus in theory are only exact for small shocks, we show that in practice they closely approximate the full non-linear model solution even for large shocks, such as cumulative changes in productivity over more than forty years.

We combine our economic exposure measures with data on bilateral political alignment that capture softer forms of political power beyond military conflict. We document large-scale changes

in both economic exposure and bilateral political alignment in response to China's emergence into the global economy following its domestic reforms of 1978. We find the largest increases in exposure to Chinese productivity growth for South-East Asian countries and resource-rich emerging countries. In the South-East Asian countries, Chinese productivity growth promotes the development of the electrical and machinery sectors through input-output linkages, whereas in the resource-rich emerging countries, it leads to an expansion of extractive industries such as mining. As countries' exposure to Chinese productivity growth increases relative to their exposure to US productivity growth, we find that they realign politically from United States and towards China. We show that this political realignment is particularly strong for African and Asian countries, and weaker for American and European countries, which on average benefit less from China's growth by our sensitivity measures.

In addition to this evidence from the natural experiment of China's emergence into the global economy, we also estimate the relationship between economic and political interests across countries, using improvements in the technology of air travel over our sample period as an exogenous source of variation. We control for time-invariant unobserved heterogeneity (such as geographical location and institutions) using importer-exporter fixed effects, and control for the sign and magnitude of productivity growth using importer-year and exporter-year fixed effects. Exploiting differential changes in trade costs between long and short distances, we show that increases in bilateral welfare exposure raise bilateral political alignment. We demonstrate the robustness of these results across a range of different econometric specifications (including panel and long-differences regressions) and measures of bilateral political alignment (including UNGA voting, strategic rivalries and formal alliances).

Taken together, our findings are consistent with the view that as a country becomes more economically dependent on a trade partner, it realigns politically towards that trade partner.

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