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Trade Wars: Nobody Expects the Spanish Inquisition

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Trade Wars: Nobody Expects the Spanish Inquisition*

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Abstract

This paper assesses the utility of economic theory of rational trade wars to predict such events or to prescribe courses of action to control their consequences. Trade wars are fundamentally political events whose causes are almost completely political and whose consequences are to a significant degree also political. Contemporary economic theory has developed during a uniquely peaceful and liberal period in world history, affecting how economists have thought about trade conflicts, leaving the profession unprepared to provide serious analysis or advice.

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Introduction[*]

Trade wars, like heart attacks, earthquakes, financial crises and, of course, the Spanish Inquisition (at least according to Monty Python) are unpredictable events. There are risk factors that increase the likelihood of an event, but point predictions are not possible. Perhaps more importantly, once one of these events has occurred, there is a body of scientific knowledge based on which the relevant experts can predict consequences of the event and prescribe courses of action to control those consequences. This last sentence is supported by the experience of heart attacks, earthquakes and financial crises, but the case of trade wars seems much less certain. Without prejudice to the Spanish Inquisition, in this paper we argue that economic theory of rational trade war provides very little explanatory leverage. The short version of the argument is that, where heart attacks are physiological events whose causes and consequences are physiological, earthquakes are geological events whose causes and consequences are geological, and financial crises (at least in a first-order kind of way) are economic events whose causes and consequences are economic, trade wars are fundamentally political events whose causes are almost completely political and whose consequences are to a significant degree also political.

Contemporary economic theory (loosely since the end of the Second World War) happens to have developed during a uniquely peaceful and liberal period in world history. This fact has had a marked effect on how we economists have thought about trade wars. In a world without trade wars, we are free to understand trade wars as being about terms-of-trade. Similarly, we can convince ourselves that the collective effort at trade liberalization has primarily been about internalization of a terms-of-trade externality, when the success of trade liberalization has rested firmly on convincing domestic politicians that "trade policy is foreign policy" (Cooper, 1972, Nelson, 1989); and in a world in which international trade is not a domestic political issue, we are free to treat the politics of trade as being about the effect of trade policy on household factor incomes. The result is that in an environment in which trade policy is very much public politics and trade wars are a very real possibility, we are unprepared to provide serious analysis or advice.

In this paper, we focus specifically on trade wars, leaving the politics of anti-trade populism for another time and place. We begin with a brief overview of the theory of rational trade wars. From there we will look back to the historical experience of trade wars and the current attempts to calculate the levels of protection implied by the theory of rational trade wars. We conclude that neither the history nor the calculations provide much in the way of evidence in favor the applicability of the theory.[1] We then look more closely at the assumption structure of the theory, focusing in particular on what would have to be true of the government's objective function for the theory of rational trade wars to be informative with respect to the behavior of actual governments. We conclude with a discussion about the likely content of those objective functions.

On Rational Trade Wars

Before proceeding to a description of the modern and contemporary theory of rational trade wars, it is necessary to say what we mean by a trade war.[2] By a "trade war", we will mean an extended period

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[1]   To return to the metaphors of heart attacks and earthquakes, we believe it is the case that we can study the effects of a trade war on such things as national income and its distribution. That is, the tools we have developed for positive analysis do not fail simply because our normative analysis fails.

[2]   We distinguish between "modern" and "contemporary" theory of rational trade wars primarily on two related grounds: explicit attention to the contents of the objective function of the state; and the explicit use of game theoretic tools. The modern theory is concerned with the former and, mostly, was done before the game theory revolution of the 1980s; while

during which a pair of countries, or groups of countries, apply instruments of trade policy with the intention of affecting a substantial share of the trade between those countries (or groups of countries). This is generally instrumental behavior, but there need be no implication that the ultimate, or unique, goal of the policy is to determine the structure of trade. However, in the theory of rational trade wars proper, as we discuss below, the assumed unique goal of trade policy is to maximize national welfare by affecting the terms-of-trade. This literature focuses on tariffs, and to some extent on quantitative restrictions, but this is without prejudice to the wide range of instruments that have been used in historical trade wars (e.g. quantitative restrictions of various sorts, navigation acts, colonial structures, embargoes, staple laws, etc.).

The modern and contemporary theory of rational trade wars is based fundamentally on the theory of the optimal tariff. In its most basic form, 2 countries and 2 goods, which is the form the great majority of the literature on rational trade wars applies, optimal tariff theory is quite simple. The policy-active country acts as a monopsonist, restricting access to the market for its importable good resulting in a fall in the price of importable on the inframarginal (i.e. still imported) units. That is, the policy results in an improvement in the terms of trade for the policy-active country. The optimal tariff just balances, at the margin, this terms-of-trade gain against the loss in welfare from the distortions in consumer and producer choices caused by that policy. The size of the optimal tariff is a function of the elasticity of the foreign country's export supply curve. Specifically, $t^{opt} = 1/\varepsilon^*$, where ε^* is the elasticity of export supply by the foreign country. Even in this textbook case, the result is deceptively simple. As Murray Kemp (1969, pg. 300) pointed out years ago:

> "Much attention has been lavished on this formula. But it provides scant guidance in the search for an optimal t since it involves two, not one, unknowns. The value of ε^* depends on the position of the foreign demand curve at which it is evaluated; the point on the foreign demand curve depends on the import demand by the tariff-imposing country; that in turn depends on the internal distribution of income; but, finally, the post-tariff distribution of income depends on the arbitrary pattern of lump-sum taxes and subsidies. There is, then, not a single optimal τ but an infinity."

We will return to these issues shortly, but first we need to turn from the case of one policy-active country to two. That is, we consider the analysis of rational trade wars. The modern theory of rational trade wars proceeds from a critique of the optimal tariff analysis that a large economy targeted by an optimal tariff would likely retaliate. This retaliation would take the form of a rational response—i.e. the adoption of an optimal tariff defined relative to the first country's tariff distorted offer curve. In the modern theory, countries will continue to retaliate in this tit-for-tat fashion until neither country can gain by changing its tariff. At that point, the trade war was over. As in Scitovsky (1942), there were two conjectures about this end point: first, that it would occur before autarky was reached; and second, that both countries would lose relative to free trade. In what has become the standard reference in the modern literature, Johnson (1953-4) showed that the first conjecture was correct, but that it was completely possible for one country to "win" a rational trade war (i.e. have higher national welfare after the trade war than under free trade).[3]

The contemporary theory of rational trade wars cuts through the details of the tit-for-tat retaliation process by applying standard game theoretic analysis to focus on the Nash equilibrium. Thus, the end point (the Nash equilibrium) becomes the trade war and the analyst can, in principle, calculate the Nash optimal tariffs for each country. Furthermore, assuming that the Nash equilibrium is unique and both countries lose, both of which became components of the conventional base-line for rational trade war analysis, it was easy to see that a trade war was a prisoners' dilemma (Riezman, 1982). Not only did

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the contemporary theory treats the objective function as unproblematic and uses game theoretic tools extensively. Our paper "Rational Trade Wars and Stupid Trade Disputes" provides a detailed survey of these, as well as earlier, bodies of research on trade wars.

[3] Later analyses argue that quota wars tend asymptotically to autarky, so both countries must lose from a trade war pursued with quotas (Rodriguez, 1974, Tower, 1975). However, Falvey (1985) argues that the tendency to autarky is produced by an unrealistically strong assumption on the distribution of quota rents.

this provide expository clarity but, faced with very low tariffs among the major trading nations of the world, trade economists were able to take advantage of the extensive body of work on how repetition, under a variety of assumptions, permits players to support cooperation (Osborne, 2004, Chapter 14). From this insight grew a whole body of work on trade cooperation and, in particular, the role of the WTO (Bagwell and Staiger, 2002).

At a minimum, the theory of rational trade wars clearly illustrates one fundamental problem with optimal tariff theory and thus contributes to pedagogy in an important way. For the purposes of this paper, however, we are interested in whether, or not, it contributes to our understanding of trade wars as they exist in the wild. To be clear, we do not expect the theory to predict the outbreak of a trade war (though we might hope it would point to risk factors), but we would like it to help us understand the appropriate response. In the next section, we briefly discuss some empirics of trade wars. We begin with historical trade wars.

Trade Wars in History

For most of human history, long-distance trade was simply too expensive to constitute a major part of any community's consumption. There was robbery and brigandage, but there is no way to think about trade war between communities. For trade wars, the key is that political leaders come to see control over trade as an essential instrument in the conflict between national powers. While we tend to associate the link between power and plenty with the mercantilist era (roughly the 17th and 18th centuries), the then common understanding of that link emerged from a longer process of state building and international political struggle between the emerging European powers. Spain, Portugal, Great Britain, the Netherlands and France struggled to establish centralized political orders domestically and dominant positions with the emerging *interational* political system. This project required the development of a more centralized state apparatus and significant increases in government revenue to cover the costs of expensive new technologies of war (Mann, 1986, Parker, 1996, Hoffman, 2015). Control over international trade was widely understood to be an essential part of this struggle (Mann, 1986, Ormrod, 2003, Findlay and O'Rourke, 2007). The control of foreign trade, including the attempt to extract fiscal resources from that trade, involved tariffs, colonies, the chartering of companies of "merchant adventurers", navigation acts, staple laws, etc. For our purposes, the essential fact, as clearly recognized by the writers in the mercantilist tradition, was that these policies had as goals both power and plenty (Viner, 1948). There is no obvious way to incorporate trade wars of the mercantilist era into the framework of rational trade wars. Note that this is not to say that we cannot represent revenue maximization as a central part of the objective of these centralizing states, but that it was only one component, and often not the most important component, of their "trade policy".[4] Unlike these policies, where trade restrictions were an essential part of a broader geo-strategic conflict, we might see the Hawley-Smoot tariffs as a trade war (Kindleberger, 1986), but again it is far from clear that rational trade war theory captures much that is essential about this case. By virtually all accounts, these tariffs were a response to macroeconomic conditions in a pre-Keynesian environment where governments lacked instruments for responding to economic downturns (and where they had very little effect, e.g. Eichengreen, 1992).

Embargoes on all, or a substantial share of, trade are closely related to these trade policies. Heckscher's (1922) study of the continental system (Napoleon's blockade of continental trade with Great Britain 1806-1814) is a classic. The early US tried embargoes a number of times during the early Republic (Irwin, 2017). Restrictions on trade were an essential part of the Nazi strategy for constructing a continental political economy (Hirschman, 1945) and wartime trade was tightly controlled by

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[4] It should be clear that there was no notion whatever of *welfare* maximization at this time. Thus, the objective function of optimal tariff theory is clearly inappropriate for this period.

embargoes (Milward, 1977).[5] Embargoes, and other forms of restriction, on trade between East and West were widely practiced during the Cold War (Milward, 1984, Hogan, 1987, Nelson, 1989, Gaddis, 2005). Perhaps even more than for the trade wars briefly discussed previously, embargo policies were driven by military and geo-strategic concerns to the exclusion of the sorts of terms-of-trade considerations that underlie the theory of rational trade wars. Embargoes have also been extensively used as instruments of policy between quite asymmetric powers. The archetypal case is embargoes against South Africa, but we see demands for similar policies today in the use of embargoes against Iran and the movement to boycott Israel over its policies with respect to Palestinians. Most of the sizable literature on these embargoes focuses on the economic effects of the policies, but there is virtually no attempt to analyze optimal policies, in part because the goals are primarily non-economic.

Trump Administration Trade Policy: A Rational Trade War?

The US started raising tariffs on imports in 2018 in a series of policy actions. First, tariffs were increased on imports on steel and aluminum against all trading partners (invoked under Section 232 of the Trade Expansion Act). Then tariffs were increased for imports from China in a wide range of sectors (invoked under Section 301 of the Trade Act of 1974). Additional tariffs on cars and car parts, again invoking Section 301 of the Trade Act of 1974, are under discussion. In response, various trading partners have raised tariffs on imports from the United States. These events could lead to further tariff increases with as possible outcome a global trade war. Table 1 provides an overview of the different tariff measures taken by the United States and its trading partners.

Table 1: Imports covered by trade measures (US$ billion)

WTO Member	Date imposed	Descriptions of Measure	Imports covered
Canada	01-Jul-18	Countermeasures on Steel and Aluminium Products	$12.8
China	02-Apr-18	Countermeasures on Steel and Aluminium Products	$3.0
	06-Jul-18	Reaction to US Section 301 (First Batch, Part 1)	$31.9
	23-Aug-18	Reaction to US Section 301 (First Batch, Part 2)	$13.3
	24-Sep-18	Reaction to US Section 301 (Second Batch)	$57.7
European Union	22-Jun-18	Countermeasures on Steel and Aluminium Products	$6.5
Mexico	05-Jun-18	Countermeasures on Steel and Aluminium Products	$3.6
Russian Federation	06-Jul-18	Countermeasures on Steel and Aluminium Products	$0.4
Turkey	21-Jun-18	Countermeasures on Steel and Aluminium Products	$1.8
United States	23-Mar-18	National Security Issue (Section 232 Trade Expansion Act) Steel & Aluminium	$41.2
	06-Jul-18	Section 301 against China's unfair trade practices (First Batch, Part 1)	$31.9
	23-Aug-18	Section 301 against China's unfair trade practices (First Batch, Part 2)	$13.1
	24-Sep-18	Section 301 against China's unfair trade practices (Second Batch)	$187.8
TOTAL			**$405.0**

Source: Calculated from notifications and WTO-Integrated Data Base.

The government of the United States has motivated the tariff increases in at least three different ways. First, as part of the policy to "Make America Great Again" the US government aims at bringing back

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[5]   For the long view, see (Davis and Engerman, 2006).

manufacturing jobs to the United States and imposing tariffs on manufacturing imports is considered an appropriate tool to do so. Second, it is considered unfair that tariff rates imposed by the US on imports into the US are higher than tariffs faced by the US on its exports. In more formal terms the objective is to make tariff rates reciprocal, meaning that tariff rates at the tariff line level imposed by the US should be at the same level as tariffs faced by the US. Third and related, the imbalance between tariffs imposed and tariffs faced is considered an important driver of the US trade deficit. Raising import tariffs on imports in general and on Chinese imports in particular would help reduce the trade deficit in general and the bilateral trade deficit with China in particular. Other factors also play a role in the tariffs imposed on imports from China: the poor protection of intellectual property rights in China, alleged enforced technology transfer of foreign companies investing in China, and the heavy involvement of the Chinese government in its economy through (implicit) subsidization of state-owned companies (SOEs). As a matter of fact, these other factors are the official reasons for the tariffs imposed on China based on Section 301 of the 1974 Trade Act.

Most economists dismiss the three main arguments for the tariff increases outlined above. Most of the reduction in the manufacturing share of employment can be explained by structural change (lower productivity growth in services combined with a low substitution elasticity between manufacturing and services). Kehoe *et al.* (2018) find that only 15% of the reduction in the manufacturing share of employment between 1992 and 2012 can be explained with the presence of trade deficits in this period, whereas most of the decline is explained by differential productivity growth. Bekkers (2019) shows in simulations with a dynamic CGE model that over a 20-year period tariff increases as in a global trade war scenario would not compensate for the decline in manufacturing in the US as a result of structural change.[6]

Many economists have pointed out that trade policy is not an appropriate tool to reduce trade imbalances, since these are driven macroeconomic on (public) savings and investment (Obstfeld, 2018). Griswold (2019) explains that "reciprocal tariffs", i.e. equal tariffs imposed by the US as faced at the tariff line level, would be at odds with the principle of MFN and would raise the administrative burden of tariff policy considerably. From our perspective, it is striking that such reciprocal tariffs would not be the outcome of a Nash equilibrium in tariffs.

Additional US tariff measures have been under discussion in 2019. The US government has considered raising tariffs on imports of cars and car parts (about 300 billion dollars) to 25% with the same legal justification as the steel and aluminum tariffs, national security under Section 232 of the Trade Expansion Act. Such tariffs would in turn provoke retaliation. In April 2019 the US also considered raising tariffs on imports of a value of 11 billion on various products from the European Union as retaliation measures for the WTO-inconsistent subsidies in the EU for Airbus. This will likely trigger retaliation by the EU on US imports (on 12 billion import value) because of WTO-inconsistent subsidies to Boeing.

Overall then, while there are many examples of trade wars in the historical record, the theory of rational trade wars would seem to have very little to say about them. The same seems to be true of current trade conflicts. Suppose we approach this a different way: can the theory of rational trade wars rationalize observed tariff structures between countries. In the next section we briefly review the computational literature on rational trade wars.

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[6]   In the global trade war scenario tariffs would rise by about 32% on average based on the estimates of the difference between cooperative and non-cooperative tariffs in Nicita *et al.* (2018). In this scenario US tariffs would increase by about 60% on average.

Counterfactual Analysis of Trade Wars

Different models are used for counterfactual analysis of trade wars. The expected effect of the tariff increases in 2018 have been analyzed with three different types of models. First, traditionally computable general equilibrium (CGE) models have been the tool for counterfactual analysis of trade policies and are still widely applied by international institutions and academics. Francois and Baughman (2018) for example analyze the expected effects of the 232 steel and aluminum tariffs on the US economy, using a short-run approach with sticky wages. Devarajan *et al.* (2018) explore the expected effects of the tariff war between the US and China on developing countries and the best response of these countries. Bekkers and Teh (2019) project the expected medium-run effects of a global tariff war based on the estimates of the difference between cooperative and non-cooperative tariffs as estimated by (Nicita, Olarreaga and Silva, 2018).

Second, dynamic stochastic general equilibrium (DSGE) models have been used mainly by international institutions and central banks to analyze the macroeconomic effects of tariff increases. (IMF, 2018) for example explores five different scenarios in the World Economic Outlook, showing that the GDP of countries in Northern America would be particularly affected by potential US car tariffs and retaliation.[7] Third, so-called new quantitative trade (NQT) models have been employed for counterfactual analysis of the potential effects of a trade war. Felbermayr *et al.* (2017) for example analyze various potential US trade policy scenarios.

All three types of models are micro-founded models handling international trade through the Armington assumption.[8] The DSGE models are dynamic, featuring forward-looking savings and investment behavior, monetary policy, and financial frictions. Most of these features are absent actual social economic accounts, thus capturing intermediate linkages as in the data. The main difference between CGE-models and NQT-models are that the former includes more behavioral parameters taken from the literature, whereas in the NQT-models many choice nests are Cobb-Douglas. CGE-models include capital accumulation in a recursive dynamic way. An important difference between DSGE-models on the one hand and CGE- and NQT-models on the other hand is the size of the Armington elasticities, which are much lower in the former than in the latter.

The three model structures conduct counterfactual analyses of a trade war in a similar way. Tariff change scenarios are designed based on either actual or expected changes in trade policy and implemented in the models to calculate the counterfactual effects of these scenarios for trade, GDP, other macroeconomic variables and sectoral output and trade effects. Table 2 summarizes the numerical estimations of non-cooperative Nash tariffs in the literature. These studies, however, differ widely on model specifications with varying degrees of complexity and data requirements (from 2x2x2 HOS models to complex global multi-sector multi-factor CGE models). The diverse features and parameter values employed in these quantitative trade models, as well as different data years and parties involved in the trade war, can partially explain the wide range of calculated Nash tariffs: from 0 to 160 percent, with a simple mean of around 40 percent. Country size is also important, with larger countries usually having larger Nash tariffs (e.g. the US against smaller countries).

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[7] Most central banks have open economy DSGE models, which can be employed to study the repercussions of trade war scenarios. Two examples are Dizioli and Van Roye (2018) and Bolt et al. (2019).

[8] New quantitative trade models often use the Eaton and Kortum specification. However, as shown in the literature in reduced form Eaton and Kortum and Armington are essentially equivalent.

Table 2. Studies estimating Nash tariffs

Study	Parties involved	time period of data	Calculated Nash tariffs	simple mean
Hamilton and Whalley (1983)	2 countries	analytical	5% to 78%	42
Whalley (1985)	2 countries	analytical	4% to 79%	42
Markusen and Wigle (1989)	US & Canada	1977	US=18% & CAN=6%	12
Lee and Roland-Holst (1999)	US & Japan	1985	US=50% & JPN=40%	45
Perroni and Whalley (2000)	7 OECD countries	1986	64% to 161%	113
Ossa (2011)	7 global regions	2004	10% to 29%	20
Whalley et al. (2012)	China and RoW	2005	0 to 33%	17
Ossa (2014)	7 global regions	2007	55% to 77%	66
Balistreri and Hillberry (2017)	US, Mexico & China	2011	US-MEX (12%/6%) & US-CHN (11%/-5%)	6
He et al. (2017)	US, EU, China & RoW[9]	2013	68% to 104%	87
Bouët and Laborde (2018)	US, Mexico & China	2011	US-MEX (14%/9%), US-CHN (7%/3%), US-MEX-CHN (10%/10%/3%)	8
Bekkers et al. (2019)	US & RoW	2014	10% to 34%	22

Note: RoW – rest of the world

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[9] Each country is modelled separately with the RoW (i.e. US-RoW, EU-RoW, China-RoW)

Tariffs of around 50 percent are usually mentioned as the result of the trade war following the Smoot-Hawley Tariff Act of 1930. The current (ongoing) US-China tariff escalation has so far resulted in tariffs of around 12 percent (in trade-weighted terms. At least for the current case, then, these estimates of Nash equilibrium tariffs seem quite high, though the actual tariffs could easily get much larger. The large range of estimated Nash tariffs hinders the practical political and empirical use of these estimates (unless a comprehensive assessment of these studies narrows down the tariff range to comply with common best-practice modelling standards).

What Went Wrong? Auditing Rational Trade War Theory

Counterfactual methods, as an application of standard trade theory, have proven their value in the positive analysis of trade policy. The same is true of econometric studies of trade flows based on those theories. So, what goes wrong when we turn to the analysis of optimal policies (non-strategic or strategic)? In this section, we consider two sorts of problem: those deriving from the complexity of the policy environment; and those deriving from the lack of a clear objective function for the policy-maker.

We have already quoted Murray Kemp on the complexity behind the apparent simplicity of the standard 2-good × 2-country optimal tariff. Things get even trickier when we turn to the case of many goods.[10] Characterizing the *n*-good optimal tariff schedule is not much more difficult than the 2-good case.[11] Unfortunately, actually calculating such a thing is problematic. First, it is a standard result that, with many goods, the tariff structure is not unique, but depends on which good is taken as the *numeraire* (Horwell and Pearce, 1970). Perhaps most importantly, although the formulae for optimal tariffs look straightforward and easy to interpret, they rely on information about cross-elasticities that, as a practical matter, policy makers simply do not possess.[12] It is important to recall here Kemp's reminder that these elasticities depend on the equilibrium (i.e. they are not generally constants). Much current theoretical work in fact adopts assumptions that ensure that this problem does not arise (e.g. quasi-linear preferences and a production structure featuring specific factors in all sectors except the *numeraire* sector, which is a freely traded Ricardian sector). This is a perfectly reasonable practice when developing a model for illustrative purposes, but when it comes to empirical and policy analysis, this is a much harder claim to accept.[13]

These problems get worse when we turn to strategic analysis. Now, even abstracting from the non-uniqueness problem, the elasticity information will depend on the Nash equilibrium. But note that both governments (in the 2-country case) must have global elasticity information about both countries so that they can identify the equilibrium tariff vectors. Of course, it is also the case that there are many, even many large, countries. Most countries work with a single tariff schedule applied to major trading partners (this is the upshot of the generalized most favored nation treatment that is one of the core commitments of WTO members).[14] Unless the underlying economy supports representation of that multi-country

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[10] According the US Census Bureau website (https://www.census.gov/econ/overview/mt0100.html) there are "more than 18,000 import commodity codes". For our purposes, we need not get into the question of whether goods are homogeneous within each of these codes, as they would need to be for a single tariff per trading partner to be applied on a tariff line.

[11] The first to present the *n*-good case was Graaff (1949) but it is also clearly presented in many advanced textbooks (e.g. Kemp, 1969, Dixit and Norman, 1980, Woodland, 1982).

[12] If we take 18,000 as the number of goods, the trade policy authority would need 18,000 direct elasticities and something like $(18,000 \times 18,000) - 18,000 = 323,982,000$ cross elasticities. It should be clear that these data do not exist.

[13] Graaf's (1949, pg. 54) warning that "to neglect [cross-elasticities] is to commit the unjustifiable act of carrying over into general equilibrium analysis assumptions appropriate to partial equilibrium analysis only" is particularly important in this context. Of course, computational analysis just generates these elasticities mechanically.

[14] There are, of course, a variety of details. However, neither special and differential treatment nor administered protection seem to be an essential part of the strategic component of trade policy that the Nash equilibrium tariff schedule seeks to characterize.

game as an aggregative game (Acemoglu and Jensen, 2013, Camacho *et al.*, 2018), the optimal policy would involve multiple tariff rates and the constrained optimal single-schedule tariff would be, understating considerably, very difficult to calculate.

The other major problem has to do with the objective function of the government. *Optimal* tariff theory requires such an objective function to give meaning to "optimal". In all textbook presentations of the theory, and most research on the subject, this objective is something called "national welfare" and that's fine for textbooks. In those presentations, confusion is eliminated by assuming that there is an unambiguous representative agent. As often as not, we simply assume that there is a well-behaved (Bergson-Samuelson) social welfare function.[15] An alternative is to assume that the structure of the economy is such that there is a positive representative agent. This generally involves assuming some version of Gorman polar form preferences (commonly identical homothetic or quasi-linear). If we also assume that the government has a utilitarian social welfare function, so there are no distributional preferences, we also get a normative representative agent and our analysis proceeds without problem. Unfortunately, these assumptions are spectacularly unrealistic and under any other assumptions the social welfare function requires ongoing redistribution to support welfare maximization.

When we move away from positive representative agents, to economies characterized by even minimally realistic taste heterogeneity among households, things get worse rapidly. Interestingly, this was seen as a key issue in the modern analysis of optimal tariffs and rational trade wars.[16] The problem from a positive perspective is that demand is sensitive to income distribution, so calculation of optimal tariffs requires information about income distribution (and household preferences). That is, as Kemp already noted for the 2 × 2 case, there is an infinity of optimal tariffs depending on the income distribution. From a normative perspective, as we just noted, redistributive policy is necessary to underwrite the existence of a coherent social welfare function. What is a problem for welfare analysis is the foundation of political-economic analysis. The usual motivation for political economic analysis is a loosely empirical claim that the existing tariff structure of an economy cannot be rationalized by optimization of social welfare. This, in turn, implies that the income distribution does not reflect any welfare optimization. However, when we turn to optimal tariff theory, once we leave the world of identical Gorman polar form preferences, the determination of the tariff structure by political action is exceptionally unlikely to yield aggregate policy preferences with any particular properties. That is, political economy takes the problems associated with heterogeneous preferences and magnifies them by providing an additional source of distortion in aggregate preferences. To make much analytical progress, then, requires a set of fairly strong (i.e. wildly counterfactual) assumptions.

Where taste and endowment heterogeneity means that we might not have a very good sense of what the objective function is for the single country whose tariff vector we want to evaluate for its consistency with the optimum, this is considerably more important in the case of Nash equilibrium tariffs. That is, not only must the analyst be confident that she knows the nature of a government's objective function but, more importantly, each of the governments (in the 2-country case) must know the objective function of the other government. If that is not the case, and even if the government knows its own objective function, neither can solve the (already quite complicated) overall system for the Nash equilibrium.[17]

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[15] From here any reference to a "social welfare function" should be understood to refer to a "Bergson-Samuelson social welfare function".

[16] The modern period in trade policy analysis is coextensive with the development of "the new welfare economics" and many of the same researchers were actively involved in both literatures (e.g. Kaldor, Scitovsky, Samuelson, Baldwin, Johnson). This is not surprising given that the new welfare economics grew out of attempts to answer Lionel Robbins (1938) question about the validity of welfare claims, illustrated by the case of gains from trade.

[17] The issue here is not uncertainty about one's opponent. As long as the types of governments (i.e. their objective functions and any other behavioral information relevant to calculating equilibrium strategies) and the distribution of those types is known, identifying optimal strategies is a well-understood problem. The issue here is that it may not be possible to know the type-space. Neither is it the point that governments are not rational, though that is something of an open question, it is that governments do not possess the knowledge or capacity to act rationally in the sense required here. Since we presume

As in the single country case, these problems are made worse by the fact that the government objective function includes more than simple welfare optimization (whatever that might mean).

The issues deriving from heterogeneity carry over to the analysis of politics as an input to the objective function of trade policy-makers in trade wars. The assumptions necessary to illustrate the interaction of domestic politics with a broad commitment to social welfare that we noted above, in both Grossman and Helpman (1995) and Bagwell and Staiger (2002), are even more severe when we want to build game-theoretic interaction on top of the domestic political analysis. As in the previous point, all players need to know the objective functions of all the players (or at least the distribution over the types of players). Quick reality check: what do we think is the objective function of the Trump administration on trade policy? How about the May administration?

While the game theoretic analysis has provided greater clarity in the interpretation of the modern theory of rational trade wars, it also raises difficulties that were not recognized in the earlier literature. We will note two: existence; and multiple equilibria. John Nash was not awarded the Nobel prize for characterizing what we now call "Nash equilibrium", that is essentially a straightforward extension of rationality to a strategic environment, but for proving that such an equilibrium exists under quite general conditions. Technically, a Nash equilibrium is a fixed point of a set of mappings representing the optimizing behavior of all the players (Nash, 1951). As long as the mappings derived from the underlying economy satisfy the conditions required by the appropriate fixed-point theorem, we can be sure that an equilibrium exists. Otherwise not. If an equilibrium cannot be shown to exist, not only is it not clear what we are talking about when we talk about Nash equilibrium tariff schedules, but any comparative static analysis would seem to lack clear foundations. Thus, the question is whether we can be confident that, given an underlying economy, an equilibrium in tariff schedules exists.

Existence for the case of 2 countries × 2 goods is relatively straightforward. Wong (2004) presents a careful analysis of the 2-country × 2-good case. In this, as in the more general case, the key is the structure of the reaction function (surface), alternatively the curvature of the offer curve (surface), and the difficulty is that these are affected by tariffs.[18] This difficulty becomes all the more severe when there are many goods. As a result, all of the attempts to prove existence of a Nash equilibrium in tariffs for the many goods case adopt quite special assumptions either on the space of strategies (Kuga, 1973), preferences of the representative agent (Kim and Roush, 1988) or the "beliefs" of the policy authority about the underlying economy (Otani, 1980). None of these papers increase our confidence that we can expect a Nash equilibrium in tariff schedules to exist generically.

Suppose we can be sure that an equilibrium exists, can we be sure that that equilibrium is unique? Debreu (1970) showed long ago that uniqueness was not necessary for analyzing the general equilibrium of an economy. However, the situation in game theory is very different. The whole point of an equilibrium is that it is a set of behaviors that is consistent—each player is playing her part of a self-enforcing solution to a strategic situation. If there are multiple equilibria, in which players part of the equilibria differ, not only does the model not predict a specific outcome, but the observed behavior is

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that both governments know this, it is far from clear how we are to interpret behavior that appears consistent with any theory of strategically rational behavior. Thus, if we want to understand the behavior of, say, the Trump (or Carter, or Reagan, or Bush, or Clinton, or Bush, or Obama) administration's trade policy it is not clear what the theory of Nash trade wars does for us. Given substantial differences in core constituency, ideology, context, *et cetera*, the problem is even worse if we want to account for continuities, or discontinuities, across these administrations. We can, and should and do, calculate/"estimate" such equilibria based on more-or-less explicit assumptions permitting such work, but when we do, as we do in our related work , we should be as clear as possible how we are filling in these huge gaps and what that means for our conclusions.

[18] This is why Johnson (1953-4) ultimately focuses on constant elasticity offer curves, and many analyses since Johnson have done the same. Wong (2004, Lemma 1) shows that, if both offer curves are convex, a Nash equilibrium in tariffs exists. Unfortunately, this condition is far from generic even in the 2 × 2 case. Thus, Wong's analysis focuses on homothetic (Theorem 1) and quasi-linear (Theorem 2) preferences of the countries' representative agents.

not even equilibrium behavior with strictly positive probability.[19] Contemporary game theoretic research approaches this issue via refinements and equilibrium selection. These turn on stories about how participants view deviations from predicted behavior off the equilibrium path (trembles, mistakes, incorrect/different theories of the strategic situation, signaling -- see e.g. Kreps, 1989) and theories that attempt to provide more complete models of agent reasoning (Perea, 2012, Brandenburger, 2014). Because the applied literature on trade wars virtually always assumes a unique equilibrium, these issues do not arise. However, given the likelihood of multiple (or no) equilibria in even modestly general trade war games, thinking more systematically about what political leaders think they are doing is surely a high-payoff exercise.

Our review of the results from attempts to calculate optimal and Nash optimal tariffs, and recalling all of the caveats that surround such analysis, suggest that observed tariffs are far lower than what the models suggest. This is actually the opening wedge for a claim that this literature successfully accounts for observed behavior. Considering the Nash optimal tariff as the reversion point of a failed attempt to liberalize trade between national economies, there are a variety of ways of accounting for cooperation. The easiest simply assumes that countries are able to commit to binding agreements to liberalize trade and applies one or another of the cooperative solutions (Mayer, 1981, Riezman, 1982). The difficulty with this analysis, for all that the results appear more consonant with existing low levels of protection, is that there is no real account of implementation. In the face of the trade policies of Trump and May, it is very hard to keep a straight face and talk about binding trade agreements. An alternative is to consider repeated interaction and consider the variety of ways that opens the door to cooperation. Unfortunately, all of this analysis is based on Nash equilibria in even more demanding environments than the one-shot analyses that yield the trade war equilibria. That is, all of the problems that we have discussed to this point apply to these analyses.

Conclusion: What Do We Learn About Trump Trade Wars from Rational Trade Wars?

We might start with the warning of David Kreps, who argues that:

> Any formal, mathematical theory is applied to a model of a given situation. This model will at best be an approximation to the situation. It is therefore crucial to have a sense—intuitive if need be but better if buttressed by theory—of when the conclusions of the theory turn on features of the model about which the model-builder is fairly uncertain. In such cases one trusts the conclusions of the theory at great peril. (Kreps, 1990, pg. 123)

So, (rational theory of trade) "War, what is it good for?" To quote Edwin Starr, in the Norman Whitfield/Barrett Strong penned Motown classic: "absolutely nothing". Even if the idea of a (positive and normative) representative agent made sense, and even if some possible government was willing to act on the preferences of that agent, and even if that government possessed the knowledge of the economy necessary to calculate an optimal tariff for itself, and even if it possessed similar knowledge about its trading partners so that it could calculate its part of a Nash equilibrium (in confidence that all other governments were doing the same, and in confidence that they were all coordinated on the same Nash equilibrium, which is taken to exist), we would have to believe that all of these things applied, at least approximately, to some specific set of existing countries in some specific interaction. Without *all* of these things being true, the idea of an actually existing Nash equilibrium tariff schedule is literally nonsense. So, as a practical matter, the theory of rational trade wars cannot tell us about actually existing trade wars. Perhaps more importantly, the notion that it tells us anything about the trade policy of the Trump administration with, say, China (or Europe, or its NAFTA partners) literally beggars belief.

Our discussion to this point has been pretty relentlessly negative. Does this mean that we believe that the collective efforts of first-rate economists who developed the theory of optimal tariffs and its

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[19] That is, with multiple equilibria, one possibility is that agents randomize over the strategies that they play in some equilibrium (they play a "mixed strategy").

extension to the theory of rational trade wars was a waste of quality effort? No. The purpose of some theory is to provide a first-order framework for understanding policy decisions and their effects, but it is the purpose of other theory is to provide a meta-analytic framework for organizing our thoughts about more complex situations. The theory of economic policy (e.g. Johnson, 1963, Bhagwati, 1971, Corden, 1997), of which the theory of optimal tariffs can be seen as a part, is an example of the second sort of theory. Simple, low-dimensional, transparently "unrealistic" theory can help us quickly develop a first response to a complex situation because the various components have proved to be a robust framework for doing such calculation. Our confidence in such a framework flows from confidence in its internal coherence and in its ability to represent precisely the causal relations which we suspect to be of first-order importance. Low dimensional general equilibrium theory plays an essential role in this sort of theory. One of the easiest things to forget when doing policy analysis is the way general equilibrium effects can interfere with partial equilibrium intuition. Training ourselves in general equilibrium helps us guard against making this mistake. Similarly, we remind ourselves to think like economists about trade wars by using the theory of rational trade wars as a lens, or the back of an envelope, when we start our thinking about the issue. In any given case, one or another of the elements that we have simplified away will strike us as particularly important for further thought. And it is to such an area that we apply to tools of detailed formal and statistical analysis.

In the case of the current trade policy of the Trump administration, the most difficult issue would seem to be figuring out what the President, and what for want of a better term we will call "advisors", are using for an objective function. Among the things it is pretty clearly not are: social welfare (however we might want to define that); reelection maximization as represented in standard political economy forces (to the extent that we can tell, the distribution of costs and benefits seems all wrong for that); and pursuit of geo-strategic goals (the policies seem too collectively incoherent to reflect such goals). At this point, we seem to fall back on personal psychology, but this is an area for which, as economists, we are manifestly unqualified.

To finish on a positive note: nothing in this paper should be seen as a criticism of the positive analysis of trade policy and its effects. The tools, theoretical, computational and econometric, with which we evaluate the effects of trade policy on national income, the distribution of national income, growth, etc. remain useful. To develop our analysis with direct application to the current situation, we could do what the mercantilists did and seek to provide practical advice based on our understanding of the politics of the situation and the psychology of Donald Trump. Alternatively, we could follow the example of analysts like Harry Johnson, who used a variety of simple models, along with practical information about the current situation, to build up an account of the incentives in that situation and the appropriate responses. Both approaches involve story-telling, and the validity of those stories rests very strongly on the facts of the matter that flesh out the story, but only the latter approach reveals the analytical structure of the story.

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