Essays on the Political Causes and Consequences of Technological Change

Sondre Ulvund Solstad

A Dissertation Presented to
the Faculty of Princeton University
in Candidacy for the Degree
of Doctor of Philosophy

Recommended for Acceptance by
the Department of Politics

Adviser: Professor Helen V. Milner

January 2020

INTRODUCTION

This dissertation is motivated by one big question: What are the political causes and consequences of technological change? Separately, the three papers herein contend that: (1) trade brings peace between countries (even if enemies do not trade with each other); (2) investment possibilities shape politics, and politics in turn shape which of these possible investments are pursued; and (3) that trade leads to economic growth, in part through increased technology use and innovation. In concert, they paint a picture in which broad currents — technological change — shape states and their relations with each other. In all three papers, revolutions in transportation technology and the associated trade this brought about is used to study how states are shaped by exposure to new economic opportunity: in their international relations, domestic politics, and economies, respectively.

Does trade bring peace? In the first paper, *Does Globalization Bring Peace? A Study of Trade and War 1845-1905*, I consider the first age of globalization and the revolution in transportation technology by which it was facilitated. Leveraging the predictable ways in which trade changed as propeller propulsion replaced sails, I explore whether more trade led to less war.

Theoretically, I propose that war is akin to a tax. This tax is equal to all expenses — in lives, labor and treasure — paid in the event of war but not otherwise, and paying it only provides one thing in return: a chance of victory. I argue that the impact of such a tax is larger for trading countries, because firms in these countries compete with firms abroad who are unaffected by the tax. I thus propose a commercial peace driven by economic integration generally (as suggested by Kant), rather than based on enemy countries' mutual dependence (as proposed by Montesquieu).

I test this theory in the first investigation of trade and war using technology-driven

changes in bilateral trade distances as an instrument for trade. I show that as countries traded more, they went to war much less. I next demonstrate — for the first time in a causal setting — that more trade brings peace between two countries even if they do not trade more with each other. Through simulations, I find that total reduction of war in this era, some 40 percent, is consistent with a model in which it is entirely attributed to the global increase in trade.

Political Competition in Dynamic Economies starts with the idea that if money matters in politics and political leaders are willing to intervene in the economy to protect their position, all investment is political. Those not connected to the regime will seek to avoid a situation in which their investments do too well relative to regime insiders, which could make the political leader act against them. This adjustment, and its opportunity cost, will in part depend on the make-up of the leader's coalition: how powerful it is and what investments they have. But it will also depend on the set of possible investments in the economy. For instance, in an agrarian economy in which investment returns are highly correlated and low in variance, the need for leader intervention will be small, and the adjustment by investors slight: the best investments are also those which lead to least intervention. But if instead the best investment opportunities — those with the highest expected return — have returns high in variance and with unclear covariance, such as in an innovation-led economy, the leaders' coalition matters much more.

I thus theorize how politics interacts with the set of possible investments in an economy — which I call economic opportunity — in ways which shape both the composition of regime coalitions and which investments are pursued in an economy. I show that even if leaders' only concerns are staying in power and to control a productive economy, and they prefer not to intervene in the economy at all, they will — if at the helm of coalitions which exclude enough people — see their economies suffer, and sometimes be compelled

to intervene. I next argue that the possibility of a dynamic economy — in which investment gains and losses shift the distribution of resources — can produce an incentive to expand coalitions. Leaders balance the cost of maintaining a larger coalition with the benefits this brings in the form of an economy which is more productive and has a lower need for intervention. I show that the riskier and more diverse the set of possible investment opportunities are, the stronger these latter incentives will be. This suggests that larger coalitions are partly determined by leaders' perceptions of economic opportunity, and especially, their predictability. This theory thus links economic opportunity with political coalitions, and political coalitions to which of these economic opportunities are pursued. I argue that this provides a way to think about how technological change affect politics, and politics shape investment in new technology.

In testing this theory, I once again leverage the technology shock of steam propulsion to generate predictions of technology driven shifts in trade. I then assume that international trade in the latter half of the 19th century provided opportunities for investment, and that these opportunities — such as production for export — had more variable returns than those elsewhere in these countries' economies. In line with theory, I find that regimes with larger coalitions were better able to take advantage of these new opportunities, and moreover, that failure to do so was a good predictor of coalition expansion. Through the provision of new and risky economic *opportunities*, the steamship thus brought about more democratic rule: Coalitions did not expand as a result of the trade undertaken — but the potential thereof and desire to exploit it.

In *Trade, Technology, and Growth* I develop a new instrument for trade based on containerization, and then explore if and how trade brought economic growth in the past half-century. This paper, which seeks to make an empirical contribution only, in addition uses and makes available several new sets of data to investigate the link between trade and

growth, democracy, and war.

The instrument developed in this paper is based on the idea that containers' strength lie in facilitating easy loading of cargo. This has meant that container hubs — intermediate ports in which a mix of an origin country's exports is exchanged for a mix of a destination country's imports — have become crucial junctures in the international trading system. I use the location of twelve early container ports to calculate "container distances" between ports, which I define as the shortest ocean route which includes both ports and at least one container hub. To calculate the length of such routes, I construct the most extensive dataset of oceanic distances in existence, with some 120 thousand international port-to-port distances, each calculated once for every month of the year to account for seasonal changes in water currents.

I then use these container path distances together with direct port-to-port distances in a gravity model of trade fitted on almost eight hundred thousand bilateral trade observations. This provides me with estimates of the global adoption of containers — or, more specifically, the reliance of international trade on container routes — in the post-World War II era, and an instrument for countries' bilateral trade that varies both by country pair and over time. I then sum these bilateral relations to construct an instrument for countries' total trade.

I find that in the post-World War II era trade indeed brought growth, and that the effect is larger than previous estimates suggest. I also find that the countries relatively favored by the shift to containers were in Northern Europe, East Asia, and North America, while the relative losers were in Sub-Saharan Africa and Eastern South America.

I then go beyond such estimates to consider the channels by which trade brought growth, and whether these channels, important outcomes in their own right, can be related to trade. To consider technology innovation, I provide a new dataset of all patents granted in the United States between 1975-2015 (5.6 million), and the citations between them

(44.6 million). I find that trade was consistently linked to higher rates of technology innovation — measured by patents' citations — undertaken by a country's residents. To explore increased technology use, I construct a technology score at the country-year level from data on 29 widely used and important technologies. I find the link between trade and technology use to be positive, and this to be responsible for about 10 percent of the effect of trade on growth. I next propose a new measure of economic specialization, defined as the Kullback-Lieber divergence between current and past export and import compositions. I find that as countries traded more, their economies so defined changed, and that this change was one channel by which trade brought economic development.

***

This dissertation intentionally deals with very large questions. I have tried to push our understanding of such questions forward, and in a few instances to suggest new or underappreciated ways of looking at them. This cannot always be successful, and the three works are not without weaknesses. While word limits and data limitations can take some blame, they cannot take all, and ultimate responsibility rests with me, and my tendency to undertake investigations with perhaps too grand ambitions. This makes it important to stress that while this dissertation for me marks the end of an important process, that process is not my engagement with the formation and refinement of these ideas.

In what follows, I provide my three papers along with main appendices, in order. I then provide all supplemental materials in the same order at the very end. Typography was adopted from templates made by Cambridge University Press and Overleaf. The graphics in this dissertation are best viewed in color.

Sondre Ulvund Solstad
Princeton University, 2019