A Tale of Two Recessions: Decomposing Import Patterns after the Pandemic and the Financial Crisis

Paul Phillips

October 21, 2022

Click here to see most recent version

Abstract: I construct a multi-sector dynamic general equilibrium model of trade between the United States and the rest of the world to investigate why the pandemic affected services trade much more adversely than goods trade, in contrast to trade patterns observed during and after the 2008 financial crisis. Different parameters in the model represent the various channels through which trade would have reacted to the two recessions in the way that it did. I calibrate parameter values to match trade and gross output data, and primary results come from holding a subset of these parameters constant and observing how closely the resultant counterfactual trade patterns resemble the data. I find that trade frictions play the biggest role in explaining post-pandemic trade, while preferences over consumption and leisure play the biggest role in explaining trade during and after the financial crisis.

1 Introduction

A simple plot of normalized trade in goods and services over the past twenty years reveals some striking observations. During the financial crisis, trade in goods fell sharply, while trade in services suffered a much slighter decline. The combined imports and exports of goods fell by 23%, while that of nondurables fell by seven percent (Federal Reserve Economic Database). During the recession driven by the coronavirus pandemic, trade in goods and trade in services both fell, but trade in *services* was much more negatively affected. In this paper, I ask why trade in goods and services behaved so differently after the two recessions, and what factors could have motivated the different trade patterns.

We can gain learn important macroeconomic lessons by answering this question. First, trade in services has increased rapidly over the past two decades (FRED), and extant trade literature has not focused on it much, often assuming that services are nontraded. Learning what factors drive trade in services would provide invaluable insight into a rapidly growing phenomenon. Furthermore, an examination of trade can provide some clarity on our present economic circumstances. A forty–year high in inflation has been partially attributed to supply chain issues, and more recent developments such as OPEC's decision to cut oil production could gum up supply chains once again. Our trade findings can therefore inform policy decisions. For example, if a post–pandemic fall in services trade was driven entirely by lockdowns, policymakers should be especially desirous to avoid using lockdowns in the future. If pandemic measures played a relatively small role compared to consumer tastes, then policymakers need not be as restrained when consider lockdowns and might want to consider other measures to stimulate demand.

The easiest explanation for recent trade patterns is that lockdowns and border closures made trade in services virtually impossible to conduct, while having a less potent effect upon trade in goods. About ten percent of trade in services comes from tourism, for example, and U.S. tourism imports fell by ninety percent in the second quarter of 2020 (Census Bureau). However, trade in services still has not fully recovered even with the lifting of pandemic restrictions, and this explanation does not suffice to provide a holistic view of why 2020 would have been so different from 2008, when governments did not impose pandemic restrictions of any sort. Myriad other factors at play include consumer tastes, an increased disutility of labor in some sectors as opposed to others, and the difficulty of investing in durable goods. Some evidence exists to show why each played a role in trade behavior, but endogeneity issues make figuring out precisely what role each factor played a difficult task. For example, consumers might have decided to consume fewer goods or services in response to a decline in trade, rather than the other way around, and both the decline in services consumption and the decline in services trade could be explained by a third factor, such as pandemic–induced trade frictions.

Because the factors explaining patterns in trade are difficult to disentangle, a structural model can provide invaluable assistance in determining just what causes what. I construct a dynamic trade model with two countries and a representative consumer in each country. Goods and services sectors will be broken down into two more sectors–durables and nondurables, in–person and remote services respectively–to mimic the differential response that different types of goods and services had to economic shocks. Production occurs in a roundabout fashion, and the representative consumer will have preferences over both labor and leisure. Important dynamics come from the consumer's disutility of labor preference in each sector, the expenditure weight placed on each sector when consuming, and shocks to the consumer's aggregate time endowment, in addition to more standard shocks such as iceberg trade costs and productivity. I discern the effect each factor had on goods and services trade by holding all other factors constant and observing how closely the resultant trade time series align with the time series observed in the data.

Preliminary results indicate that trade frictions play the biggest role in explaining trade movement during the pandemic, especially for services trade. Consumer tastes and the disutility of labor play the biggest role in explaining trade patterns during the financial crisis.

1.1 Literature Review

This paper complements scholarship on the disproportionate decline in trade after the 2008 recession. Bems, Johnson, and Yi (2013) survey this literature, concluding that a collapse in aggregate expenditure on trade–intensive durable goods was the main driver of the trade collapse, followed by shocks to credit supply. Eaton, Kortum, Neiman and Romalis (2016) use a structural model to counterfactually decompose recession–era trade by the factors that could have caused it. Levchenko, Lewis and Tesar (2009) take a more reduced–form approach, using disaggregated U.S. trade and production data to evaluate various explanations for the recessionary trade decline. Other papers that examine the influence of financial frictions on the trade collapse are Amiti and Weinstein (2011), Chor and Manova (2012) and Paravisini et al. (2012), and other papers focusing primarily on expenditure effects and Bems et al. (2010, 2011) and Bussière et al. (2013). Kee et al. (2013) and Gawande et al. (2011) take a look at post–recessionary protectionsim, concluding that since most countries actually liberalized during the crisis, protectionism does not satisfactorily explain any declines in trade during the Great Recession. I will expand this analysis to the more recent economic downturn and determine what factors would have behaved differently in 2008 compared to 2020. Furthermore, many of these papers do not discuss the difference between trade in goods and services, and often simply assume that services are non–traded. I add to the trade literature by building a model that explicitly incorporates services and making a comparison between the drivers of goods trade and the drivers of services trade.

My research also contributes to a more recent body of research on how the pandemic disrupted supply chains. Jiang, Rigobon and Rigobon (2021) use a stylized model of a supply chain to find that in the presence of substantial supply uncertainty, multinational firms choose to orient their supply chains in a manner that is not optimal for each individual producer but minimizes the possibility of supply disruptions. Data–driven papers on supply chain disruptions include Bonadio, Huo, Levchenko, and Pandalai–Nayar (2021), which looks at supply chains among sixty–four countries, and Meier and Pinto (2020), which shows that sectors that were more exposed to Chinese intermediate goods imports suffered larger contractions in production and trade during the pandemic. Other papers, such as Cavallo and Kryvtsov (2021), Santacreu and LaBelle (2021), and Ha, Kose and Ohnsorge (2021) focus more on how supply chain disruptions contributed to inflation. My paper does not directly discuss supply chains or inflation, but by using a roundabout production structure to explain why trade fell in certain sectors more than others, we gain a better understanding of *why* supply chains broke down and derive policy implications from that understanding.

An extensive body of structural literature before the pandemic also focused on global value chains. My model framework borrows heavily from Alessandria, Kaboski, and Midrigan (2012), a paper that uses inventories to explain trade wedges between standard models and the data. Zhou (2021), Carreras–Valle (2022), and Lee and Yi (2018) also analyze global value chains in the context of external situations such as trade wars or storage uncertainty.

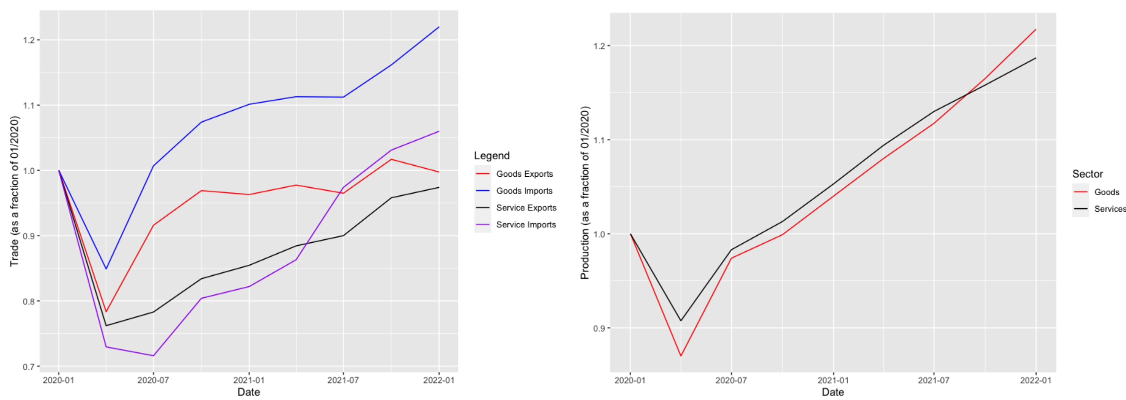
The rest of the paper proceeds as follows. Section 2 introduces stylized facts behind goods and services trade in the 2008 and 2020 recessions, as well descriptive evidence of what factors might have driven them. Section 3 introduces the model. Section 4 explains how I calibrated and estimated the model, while Section 5 displays results. Section 6 concludes.

2 Descriptive Statistics

Figure 1a) shows that while both goods trade and services trade declined substantially in 2020, goods trade fell to 80–85% of its pre–pandemic value while services trade fell to 75% of its pre–pandemic value. Furthermore, goods trade has since recovered to its pre–pandemic level, while services trade has not. However, this post-pandemic pattern in trade does not match a similar pattern in production; Figure 1b) shows that the patterns for trade do not hold for gross output. In fact, gross output in the U.S. displayed a slightly *lower* proportional decline for services than for goods, with services only decreasing by less than ten percent between Q1 2020 and Q2 2020 and goods decreasing by about thirteen percent. These observations suggest that there must exist some factor unique to trade that does not apply to the economy as a whole.

As shown in Figure 2, goods and services also display quite different trade patterns in the two major financial crises that have occurred in the past twenty years. While service imports were virtually unaffected by the 2008 financial crisis, goods imports dropped from around 140% of their 2000 levels to 110%. This statistic provides a clear contrast with goods and services trade in the past couple of years.
I consider four major explanations for why trade behaved in this manner:

1. The pandemic introduced new frictions to trade that affected services more adversely than goods. These frictions were not present during the financial crisis.



(a) U.S. Trade since 2020 (b) U.S. Production since 2020

Figure 1: Pandemic–Era Production and Trade

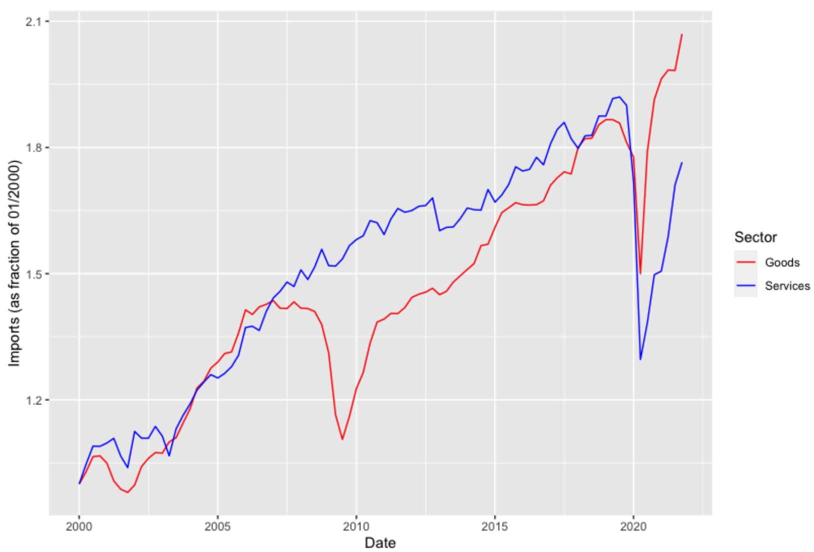


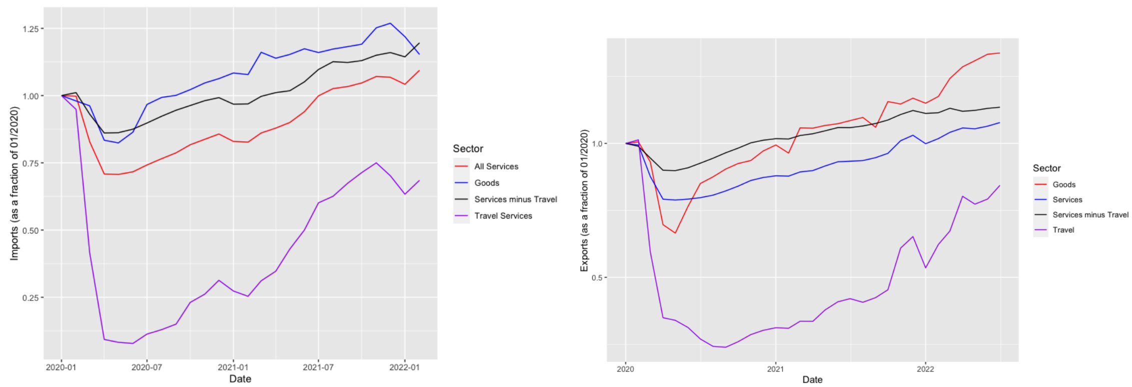
Figure 2: U.S. Imports since 2000

2. Consumers' tastes shifted from goods to services during the financial crisis, and from services to goods during the pandemic.

3. Either the financial crisis or the pandemic altered the productivity of investing in durable goods, a heavily traded sector.

4. The disutility of labor rose for employees in service sectors during the pandemic, and for employees in goods sectors during the financial crisis.

Throughout the remainder of this section, I will introduce some descriptive evidence supporting each of my posited explanations. The perhaps most obvious explanation for recent trade patterns is that border closures and lockdowns rendered several types of service trade virtually impossible. At the start of the pandemic, most countries, including the United States, closed their borders and shut down normal business operations. These measures would affect both goods and services trade, but goods trade could continue (albeit with substantial frictions) while some types of services trade such as tourism or transportation services would disappear entirely. We observe this phenomenon in Figure 3; while aggregate services declined by eighteen percent between January 2020 and April 2020, travel services fell by almost a hundred percent. Meanwhile,



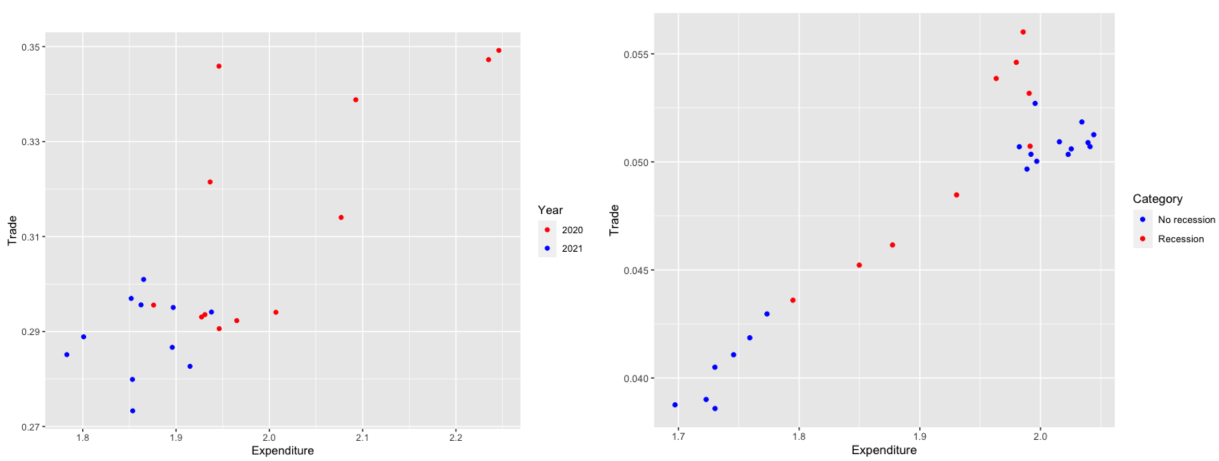
(a) Imports

(b) Exports

Figure 3: Services by Industry

services without travel services declined by less than goods did. However, while the initial (likely pandemic–induced) drop was more severe for goods than services without travel, service imports and exports have still had a slower recovery than goods imports and exports. Furthermore, travel services have still not recovered to their pre–pandemic levels even after countries re–opened, suggesting that some other force is at work than people simply not being able to conduct services trade. Did trade in travel services plummet because agents *couldn't* conduct trade in services, or did trade in services fall because they, for multiple potential reasons, chose not to?

One final observation is that no external shock of this nature occurred during the financial crisis, so closures and lockdowns cannot provide a full account of the contrast in trade patterns between the 2008 and 2020 recessions.



(a) U.S. Trade and Expenditure since 2020

(b) U.S. Trade and Expenditure since 2008

Figure 4: Trade and Expenditure (Ratio of Services–to–Goods)

Figure 4 represents the "expenditure" explanation for patterns in trade. Bems et al. (2013) and Eaton et al. (2016) document that during the 2008 recession consumer demand for durable goods fell, and this fall in demand drove the fall in goods trade. Figure 4b) corroborates this story by showing that in months where service trade was lower relative to goods trade, consumer expenditure on services was also lower relative to consumer expenditure on goods. A similar reasoning could explain stylized trade facts in 2020; because the consumption of in–person services presented an especially high risk of contracting the coronavirus, agents might have shifted their preferences from services to goods after the shock of the pandemic hit. Agents might have been particularly unwilling to consume foreign services. However, Figure 4 only shows a correlation between consumer preferences and imports, not a causation, and alternative explanations are plausible. Perhaps consumers spent less of their income on services because a fall in trade restricted the amount of services they could consume, and this fall in trade occurred for some other reason such as border closures.

The second consumer choice explanation for a fall in services trade is complementary to the first, and

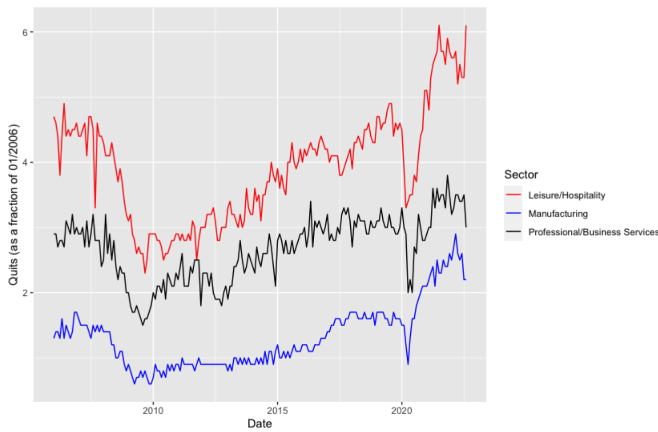


Figure 5: Quits Rate in Selected Industries

concerns agents' disutility of labor. Figure 5 shows the quits rate for selected industries, where the quits rate is the number of quits per month as a percentage of total employment. The quits rate, while higher in general for service industries than for manufacturing, fell more steeply for service industries during the Great Recession, and the quits rate in service industries that rely on face–to–face contact has skyrocketed since the pandemic. If Americans in trade–exposed service industries left the labor force at high rates, this "Great Resignation" could negatively affect U.S. service exports, and by a similar logic a high quits rates among foreign service workers would negatively affect U.S. imports. Just like consumer preferences, this relationship suffers from strong endogeneity concerns. If trade in services falls during the pandemic for some other reason, employment in trade–exposed sectors would decline. Moreover, other factors such as consumer expenditure or border closures could lead to both a higher quits rate among service workers and a decline in services trade.

We must also consider durable goods *investment*, as opposed to preferences between different sectors, as a

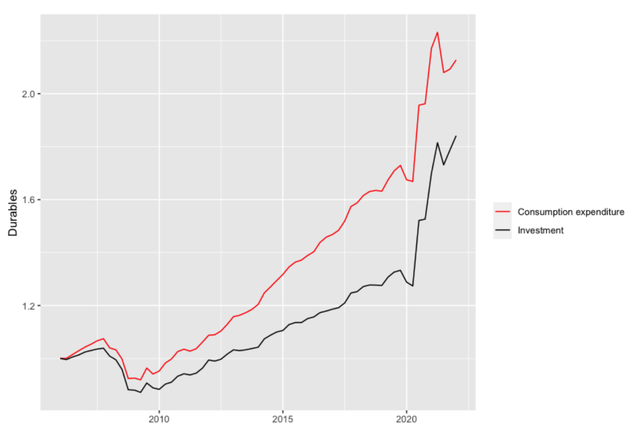


Figure 6: Investment in Durable Goods

factor that influences trade patterns. Bems et al. (2013) note the decreased efficiency of making investments during the financial crisis. As shown in Figure 6, while durable goods investment fell in 2008 and took years to recover, no protracted drop in investment happened in 2020. Furthermore, durable goods investment fell by more than durable goods consumption during the financial crisis. Since durable goods are a heavily traded sector, a decrease in investment efficiency would explain why goods trade performed worse after 2008 than it did in 2020. We do not know, though, if durable goods investment is falling because people's preference for durable goods has declined, or if people are spending less on durable goods because of the difficulty of making investments.

The stylized facts presented in this section indicate multiple possible explanations for why services trade declined more in 2020 and goods trade declined more than goods trade during the pandemic and goods trade declined more than services trade during the financial crisis. I will also consider two other, more standard mechanisms: productivity shocks and trade frictions. It is not clear which explanation dominates the others, and determining causality can be difficult. A structural model can therefore provide some invaluable clarity in disentangling the precise contribution that each effect has on recessionary trade patterns, and I turn next to the enumeration of such a model.

3 Model

The model is dynamic and consists of a representative consumer in two countries, corresponding to the United States and the rest of the world.[1] There are four sectors: durable goods, nondurable goods, in–person services, and remote services; remote services encompass activities like financial services or information technology that can be produced remotely, while in–person services are services like hospitality or tourism that cannot. The representative consumer allocates their time in each of these sectors between labor and leisure. Goods and services are put together using a roundabout production method where one of the inputs is a composite intermediate good made with final output from all four sectors.

3.1 Production

A continuum of producers in country i, sector s at time t will use labor and a composite intermediate to produce output with the following Cobb–Douglas formulation

$$X_{ist} = (m_{ist})^{\sigma_{ist}}(l_{ist})^{1-\sigma_{ist}}$$

where our Cobb–Douglas parameter varies across countries and across time. m_{ist} is a composite intermediate produced with final production from all four sectors, reflecting the fact that services are often needed to produce goods and vice versa. As a function of inputs from all four sectors, m_{ist} is given by

$$m_{ist} = \prod_{n=1}^{4}(\frac{m_{inst}}{\mu_{int}})^{\mu_{int}}$$

The market is perfectly competitive, so producers have the profit function

$$\pi_{ist} = p_{ist}X_{ist} - \sum_{n=1} p_{int}m_{inst} - w_{ist}l_{ist}$$

taking prices as given.

3.2 Aggregation

Consumers in each country take in both imported goods and home–produced goods in every sector. They aggregate the goods to form a composite that will either be consumed or recycled as an intermediate. For country i, sector s, time t:

$$y_{ist} = \omega_{is}\big(\Omega_{it}y_{Hist}^{\frac{\gamma-1}{\gamma}} + \tau_{st}^{\frac{1-\gamma}{\gamma}}y_{Fist}^{\frac{\gamma-1}{\gamma}}\big)^{\frac{\gamma}{\gamma-1}} \tag{1}$$

[1] The "rest of the world" here refers to the U.S.'s top twenty trade partners. I exclude Vietnam and Malaysia, for which I could not find data, and include Indonesia.

This aggregation entails using a CES technology to combine home goods, denoted by H and foreign goods, denoted by F. This CES technology is governed by elasticity parameter γ and iceberg transportation costs τ_{st}, the latter of which I will calibrate so that y_{Hist} and y_{Fist} match production and export values in the data. ω_{is} and Ω_{is} are utility weights, calibrated so that prices in some base period are one. The aggregated y_{ist} is either consumed/invested or recycled as an intermediate input in one of the four sectors.

3.3 Consumption

The representative consumer in country i chooses consumption and labor/leisure to maximize

$$U_{ist} = \sum_{t=0}^{\infty} \beta^t \big[\big(c_{it}^{\frac{\theta-1}{\theta}} + \sum_{s=1}^{4} (H_{ist}(1-\mu_{ist}) - \phi_{ist} h_{ist})^{\frac{\theta-1}{\theta}} \big) \big] \ \forall t$$

$$c_{it} = \prod_{s=1}^{4} (\frac{c_{ist}}{\eta_{ist}})^{\eta_{ist}}, \ \sum_{i=1}^{4} \eta_{ist} = 1$$

The consumer has a certain stock H_{is} of time available for each sector, and they must decide to allocate that time to either leisure or to working. ϕ_{ist} determines the consumer's disutility of labor in sector s. Sector 1 here is durable goods, which accumulate over time. Durable goods build up according to the accumulation equation

$$c_{1,i,t+1} = \chi_{it} x_{it}^{\alpha} c_{i1t}^{1-\alpha} + (1-\delta) c_{i1t} - \frac{\psi_{it}}{2} (x_{it} - \overline{x}_{it})^2 \tag{2}$$

In other words, the durable goods allocation next period is equal to undepreciated durable goods from this period in addition to a Cobb Douglas function of investment (x_{it}) and the durable goods allocation this period. χ_{it} governs the efficiency of investment, α governs adjustment costs, and δ is the depreciation rate. The consumer also faces investment adjustment costs governed by ψ_{it}, where $\overline{x}_{it}$ is the steady–state value of investment.

The consumer's budget constraint will be

$$p_{i1t} x_{it} + \sum_{s=2}^{4} p_{ist} c_{ist} \leq \sum_{s=1}^{4} w_{ist} h_{ist} + E_{it} \tag{3}$$

where E_{it} is a lump-sum payment from the representative consumer of one country to another equivalent to the value of the trade deficit.

3.4 Equilibrium

A competitive equilibrium in this economy consists of the following:

- Consumers maximize utility subject to their budget constraint.
- Firms maximize profit.
- Final good markets clear:

$$y_{i1t} = \sum_{n=1}^{4} m_{in1t} + x_{it} \tag{4}$$

$$y_{ist} = \sum_{n=1}^{4} m_{inst} + c_{ist} \ \forall s \in \{2,3,4\} \tag{5}$$

- Input market clears:

$$X_{ist} = y_{iHst} + y_{iFst} \ \forall i \ \forall s \ \forall t \tag{6}$$

- Labor market clears:

$$l_{ist} = h_{ist} \ \forall i \ \forall s \ \forall t$$

3.5 Equilibrium Conditions

Here, I will lay out all the equilibrium conditions that will be used in calibration and estimation. The conditions are broken down by the part of the model to which they belong.

3.5.1 Firms

Firms maximize profit over the composite intermediate good and labor, so with the Cobb–Douglas production function we get two first–order conditions and a price index.

$$P_{int} = p_{ist}\sigma m_{ist}^{\sigma-1} l_{ist}^{1-\sigma} \frac{\mu_{in} m_{ist}}{m_{inst}} \tag{7}$$

$$w_{it} = (1-\sigma) p_{ist} m_{ist}^{\sigma} l_{ist}^{-\sigma} \tag{8}$$

$$P_{ist}^{f} = \prod_{n=1}^{4} P_{int}^{\mu_{int}} \tag{9}$$

3.5.2 Aggregation by Origin

At the initial level of aggregation, consumers use a CES function to combine home and foreign goods. We can set this up as a cost minimization problem as in Alessandria et al. (2012):

$$\begin{aligned} \min_{y_{Hist}, y_{Fist}} \quad & p_{Hst} y_{Hist} + p_{Fst} y_{Fist} \\ \text{s.t.} \quad & y_{ist} = \omega_{is} \big(\Omega_{is} y_{Hist}^{\frac{\gamma-1}{\gamma}} + \tau_{st}^{\frac{1-\gamma}{\gamma}} y_{Fist}^{\frac{\gamma-1}{\gamma}}\big)^{\frac{\gamma}{\gamma-1}} \geq \overline{Y} \\ & y_{Hist}, y_{Fist} \ \geq 0 \end{aligned}$$

where $\overline{Y}$ is some arbitrary minimal level of production. The first–order conditions from this problem give us

$$y_{Hist} = \big(\frac{p_{Fst}}{\Omega_{is} p_{Hst}}\big)^{\gamma} \tau^{\gamma-1} y_{Fist} \tag{10}$$

as well as a price index

$$P_{ist} = \frac{1}{\omega_{is}} \big(\Omega_{is}^{\gamma} P_{Hist}^{1-\gamma} + (\tau_{st} P_{Fist})^{1-\gamma}\big)^{\frac{1}{1-\gamma}} \tag{11}$$

3.5.3 Consumers

At the level of aggregate consumption, the representative consumer has the FOC

$$\phi_{ist}(H_{st}(1-\mu_{ist}) - l_{ist})^{\frac{-1}{\theta}} = \frac{c_{it}^{\frac{-1}{\theta}}}{P_{it} w_{ist}} \ \forall s \tag{12}$$

This equation relates consumption to labor and leisure. Going down to the sector level, first–order conditions are

$$\frac{\eta_{ijt}}{c_{ijt}} = \frac{\eta_{ijt}}{c_{ij't}}, \ j \in \{2,3,4\} \tag{13}$$

$$\frac{y_{it}\eta_{i2t}}{\beta c_{i2t}} \frac{P_{i1t}}{\chi_{it}\alpha(\frac{x_{it}}{c_{i1t}})^{\alpha-1} - \psi_{it}} = \big[(1-\delta) + (1-\alpha)\chi_{it+1}\big(\frac{x_{it+1}}{c_{i1t+1}}\big)^{\alpha}\big] \frac{P_{i1t+1}}{\chi_{it+1}(\frac{x_{it+1}}{c_{i1t+1}})^{\alpha-1}\alpha - \psi_{it+1}} \frac{c_{it+1}\eta_{i2t+1}}{c_{i2t+1}} + \frac{y_{it+1}\eta_{i1t+1}}{c_{i1t+1}} \tag{14}$$

Finally, we have market clearing conditions for the first and second stages as well as the budget constraint. This completes our characterization of the equilibrium.

4 Calibration and Solving the Model

This section proceeds in three steps. First, I describe the data that I used to calibrate the model. The solution method then follows in two steps; I first find parameter values so that my data satisfies the equilibrium conditions detailed in section 3.5, and then I solve the model given those parameters to reverse–engineer the data. I can then consider various counterfactual equilibria to determine how factors in the model affected American trade.

4.1 Data

Each time period corresponds to one quarter, and the two countries in the model correspond to the United States of America and the rest of the world (ROW). The ROW is an aggregation of around 20-30 countries in the U.S.'s top thirty trading partners, comprising about eighty percent of U.S. trade. I observe data on the value of U.S. imports and exports (ROW imports and exports are defined in reverse), the value of U.S. and ROW gross output, the value of U.S. and ROW durable goods investment, U.S. and ROW aggregate price levels, and U.S. price levels in durable goods, nondurable goods, and services. All U.S. data comes from the Federal Reserve Economic Database, while sources for non–U.S. data are the OECD and Bloomberg [2].

Each allocation in the data corresponds to the *value* of that allocation in the model. For example, the data value for U.S. imports in durable goods would be equal to $p_{F1t}y_{FH1t}$ in the model. I obtain values of $y_{HHst}p_{Hst}$ and $y_{FFst}p_{Fst}$–goods intended for domestic consumption–by subtracting the value of exports from the value of gross output for both regions. U.S. price indices, meanwhile, come from the sector–level consumer price index with Q1 2014 taken as the base period. To compute a price index for the ROW, I calculated the average of CPIs for all foreign countries in my sample during the relevant quarter, weighted by the amount of trade each country does with the United States.

(a) Sectoral U.S. price levels (b) U.S. and ROW aggregate price levels

Figure 7: Price data

Figure 7 shows the U.S. price indices for durable goods, nondurable goods, and services over time. Durable goods show a steady decline in prices over the past sixteen years, while service prices show an even faster increase, reflecting increased expenditure demand for services and decreased demand for durables. Prices in all three sectors have all shot up in recent months due to inflationary pressures.

4.2 External Calibration

This section describes the parameters to which I assigned values, rather than computing values based on data and equilibrium conditions. Table 1 displays a complete accounting of these values.

[2]See appendix for details on the construction of foreign output time series.

Parameters	Interpretation	Value
θ	Consumption–leisure elasticity	.5
β	Discount factor	.987
α	Investment Cobb–Douglas	.5
δ	depreciation rate	.026
σ	First–stage production Cobb-Douglas parameter	.546

Table 1: Externally Calibrated Parameters

The values for α, β, and δ all come from Eaton et al. (2016). I assigned a value for σ using the World Input–Output Tables from 2014 and the Cobb–Douglas production function from the model. A σ of .547 means that slightly over half the factor expenditure in production is given to the composite intermediate good rather than labor.

4.3 Internal Calibration

Here I describe my calibration of the other parameters. This calibration uses data and the equilibrium conditions from the model.

4.3.1 Utility Parameters

Without any intertemporal component, each η_{ijt} would simply be the fraction of total expenditure in country i at time t that is covered by sector j. With the intertemporal durable goods component, however, it's not that simple. I will make use of the the production index in (2) to figure out what ηs have to be. However, I only have data on *nominal* price levels, which means that we need to modify the equation. I use a capital letter Y to denote $y_{ist}P_{ist}$. The equation is now

$$\frac{Y_{it}}{P_{it}} = \prod_{s=1}^{4} (\frac{Y_{ist}}{\eta_{ist}P_{ist}})^{\eta_{ist}}$$

I have data on nominal values for the Y's (gross output plus imports minus exports), as well as all the price levels[3]. To reduce the equation to one variable, I need to fill in the other parameters.

To begin, note that for sectors 2,3, and 4 there is no intertemporal equation. We can make η_{12t}, our non-durable goods parameter, our unknown variable and write η_{13t} and η_{14t} in terms of it.

$$\begin{aligned} \eta_{i2t}y_{it} &= y_{i2t}P_{i2t}\frac{\eta_{i3t}y_{it}}{y_{i3t}P_{i3t}} \\ \Rightarrow \quad \eta_{i2t}y_{i3t}P_{i3t} &= \eta_{i3t}y_{i2t}P_{i2t} \\ \Rightarrow \quad \eta_{i2t}Y_{i3t} &= \eta_{i3t}Y_{i2t} \end{aligned}$$

Since I have data on expenditure for each sector, I can back out η_{i3t} or η_{i4t} as a function of η_{i2t}. We can find η_{i1t} using the knowledge that all the expenditure shares must sum to 1.

$$\eta_{i1t} = 1 - \eta_{i2t}\big(1 + \frac{y_{i3t}P_{i3t}}{y_{i2t}P_{i2t}} + \frac{y_{i4t}P_{i4t}}{y_{i2t}P_{i2t}}\big)$$

The y index equation then reduces to one variable, η_{i2t}, which may be solved for. I follow this procedure for the US first, then once I have η_{i4t} I can find all foreign price indices and use them to solve the same problem for the rest of the world.

In the ten years between the Great Recession and the pandemic, Americans' preference for remote services rose while preferences for durable goods fell and preferences for nondurables and in–person services

[3] I only have the price level for aggregate services, since I came up with the in–person and remote categories, but since service goods can't be stored this index can be thought of as $P_{13t}^{\eta_{13t}}P_{14t}^{\eta_{14t}}$, which appears in the index equation

	Great Recession		Pandemic	
Sector	US	ROW	US	ROW
Durables	.204	.167	.112	.244
Nondurables	.129	.183	.104	.202
In–person services	.238	.323	.266	.256
Remote services	.428	.328	.518	.297

Table 2: Consumer Preference Parameters

	Great Recession		Pandemic	
Sector	US	ROW	US	ROW
Durables	.136	.174	.122	.159
Nondurables	.141	.195	.103	.231
In–person services	.258	.313	.263	.283
Remote services	.465	.319	.512	.328

Table 3: Consumer Preference Parameters without Intertemporal Accumulation

remained largely unchanged. Advances in technology or in living standards may have induced this behavior. Compared with the United States, consumers in the rest of the world had a higher preference for both types of goods, a comparable preference for in–person services, and a much lower preference for remote services, again reflecting differences in standard of living and available technology.

A comparison of Table 2 and Table 3 shows that Americans' preferences for durable goods during the Great Recession fall when the representative consumer is not allowed to invest. Without the benefits accruing from accumulated value over time, Americans may simply value durable goods less. During the pandemic, the cessation of investment does not make any large difference to consumer preferences. For ROW consumers we see the opposite pattern; the weight assigned to durable goods falls during the *pandemic* when investment cannot take place.

4.3.2 Prices

We have data on US prices for durable goods, nondurable goods, and services; by normalizing the price index for in–person services to one, we can back out the index for remote services. We also have data on US production (equal to gross output minus exports), US exports, US imports, and foreign production. The equations for nominal imports and exports are given below:

$$USDomestic_{st} = \omega_{US,s}\Omega^{\gamma}_{US,s}(\frac{P_{US,s,t}}{p_{US,s,t}})^{\gamma-1}Y_{US,s,t} \tag{15}$$

$$USImports_{st} = \omega_{US,s}(\frac{P_{US,s,t}}{p_{ROW,s,t}\tau_{st}})^{\gamma-1}Y_{US,s,t} \tag{16}$$

$$USExports_{st} = \omega_{ROW,s}(\frac{P_{ROW,s,t}}{p_{US,s,t}\tau_{st}})^{\gamma-1}Y_{ROW,s,t} \tag{17}$$

$$ROWDomestic_{st} = \omega_{ROW,s}\Omega^{\gamma}_{ROW,s}(\frac{P_{ROW,s,t}}{p_{ROW,s,t}})^{\gamma-1}Y_{ROW,s,t} \tag{18}$$

I calibrate ω_{is}, Ω_{is}, and γ so that all prices in the first quarter of 2014 are 1. First, (14) and (17) give us

$$\omega_{is} = \frac{Y_{iis,01/14}}{Y_{is,01/14}\Omega^{\gamma}_{is}} \tag{19}$$

and (14) and (15) give us

$$\tau^{1-\gamma}_{s,01/14} = \frac{USImports_{s,01/14}}{USDomestic_{s,01/14}}\Omega^{\gamma}_{is} \tag{20}$$

Going to (10), we substitute out for τ and $\omega_{US,s}$ while replacing all prices with 1. This enables us to solve for $\Omega_{US,s}$, and we find that

$$\Omega_{US,s} = \left(\frac{USDomestic_{s,01/14}}{Y_{US,s,01/14}}\right)^{\frac{1}{\gamma}}$$
$$\Rightarrow \Omega_{ROW,s} = \left(\frac{ROWDomestic_{s,01/14}}{USExports_{s,01/14}} \frac{USImports_{s,01/14}}{Y_{US,s,01/14}}\right)^{\frac{1}{\gamma}}$$

where the second line comes from (16), (17), and (19). Using (18), we find $\omega_{US,s}$ and $\omega_{ROW,s}$. Finally, we substitute τ and $\omega_{ROW,s}$ to figure out what γ has to be. To satisfy (10) for the ROW with unit prices, it must be that $\gamma = 2$. This calculation places our value for γ reasonably close to the value of $\gamma = 1.5$ assumed by Alessandria et al. (2012).

Now let's circle back and use (14)–(17) to find trade costs in every period. Putting the four equations together leads to

$$\tau_{s,t} = \left(\frac{USImports_{st}\Omega^{\gamma}_{US,s}}{USDomestic_{st}\Omega_{ROW,s}} \frac{USExports_{st}}{USDomestic_{st}}\right)^{\frac{1}{2(1-\gamma)}} \tag{21}$$

Table 4 displays trade cost values for the four sectors during the Great Recession (Q4 2007–Q4 2009) and since the pandemic (Q1 2020–present). Service sectors have substantially higher trade cost values than goods sectors, reflecting the relative newness of services trade and the enhanced difficulty of trading intangible products. Comparing the two recessions, durable goods trade costs fell slightly, while trade costs for in–person services nearly doubled. Trade costs for remote services were higher than trade costs for in–person services fifteen years ago, but the relationship has since reversed.

τ_{st}	Great Recession	Pandemic
Durables	3.03	2.33
Nondurables	2.93	3.21
In–person services	129	222
Remote Services	188	175

Table 4: Iceberg Transportation Costs

(14)–(17) will also get us price indices. Note that all price indices are normalized to 1 in the first quarter of 2014.

Figure 8 compares calibrated prices in the U.S. to calibrated prices in the ROW. The price index for durable goods has been on a downward trend across time. The price index for remote services has been rising more or less linearly over time, reflecting increased demand, while the index for in–person services at the start of the pandemic rose sharply for the ROW[4] at the start of the pandemic, when such services became much harder to obtain. All sectors except in–person services have become more expensive in recent quarters, reflecting high inflation.

4.3.3 χ and ψ

I can back out these two parameters, which govern the efficiency of investment, using data on the nominal value of US durable goods investment, aggregated production for Y_{i1t} and Y_{i2t}, and sector price levels for all sectors in all countries. First, we use the capital accumulation equation with prices (remember all data

[4] Remember the price index for in–person American services has been normalized to 1.

(a) U.S. price indices

(b) ROW price indices

Figure 8: Prices

is nominal) to put ψ in terms of χ.

$$
\begin{aligned}
y_{i1t+1} &= \chi_{it} x_{it}^{\alpha} y_{i1t}^{1-\alpha} - \frac{1}{2}\psi_{it} x_{it}^2 \\
\frac{Y_{i1t+1}}{P_{i1t+1}} &= \frac{\chi_{it}}{P_{i1t}} X_{it}^{\alpha} Y_{i1t}^{1-\alpha} - \frac{\psi_{it}}{2}\frac{X_{it}^2}{P_{i1t}^2} \\
\psi_{it} &= 2P_{i1t}\frac{\left(\frac{\chi_{it}}{P_{i1t}} X_{it}^{\alpha} Y_{i1t}^{1-\alpha} - \frac{Y_{i1t+1}}{P_{i1t+1}}\right)}{X_{it}^2}
\end{aligned}
$$

Equation (12) then gives us $\chi_{i,t+1}$.

4.3.4 Wages, Labor, Consumption

The remaining parameters in need of calibration are productivities A_{it} and disutility of labor ϕ_{ist}. I solve for wages using the market clearing conditions and disutility of labor using the consumer's first–order conditions for consumption.
From (7) and (8) we have that

$$
w_{it} = \big((1-\sigma)A_{it}p_{ist}\big)^{1-\sigma}\big(P_{it}\frac{1-\sigma}{\sigma}\big)^{\frac{\sigma}{\sigma-1}} \tag{22}
$$

The productivity term A_{it} is the only term in this equation we haven't calibrated and don't have data for. Next, I use the first–stage market clearing condition to obtain an expression for l_{ist}:

$$
\begin{aligned}
A_{it} m_{ist}^{\sigma} l_{ist}^{1-\sigma} &= y_{ijst} + y_{iist} \\
&= \frac{Y_{ijst}}{P_{jst}} + \frac{Y_{iist}}{P_{ist}} \\
\Rightarrow \frac{A_{it} w_{ist} l_{ist}}{P_{it}(1-\sigma)} &= \frac{Y_{ijst}}{P_{jst}} + \frac{Y_{iist}}{P_{ist}}
\end{aligned}
$$

where the last equation comes from incorporating (8). We can get an equation for labor in each sector that, once again, does not have anything we don't know other than productivity. This labor expression and (4) can then enable us to find consumption:

$$
c_{it} = \frac{\sum_{s=1}^{4} w_{ist} l_{ist} + E_{it}}{P_{it}}
$$

which comes from the consumer's budget constraint, and

$$m_{ist} = (\frac{\text{Imports}_{ist} + \text{Domestic Production}_{ist}}{A_{it}P_{it}l_{ist}^{1-\sigma}})^{\frac{1}{\alpha}}$$

which comes from the Cobb–Douglas first–stage production function. Finally, we have second–stage market clearing (5). There are two equations with the two unknowns of A_{1t} and A_{2t}, so we can solve for productivity. I need to use consumer optimality conditions for intermediate and final goods to solve for values of ϕ. (6) allows me to write labor:

$$h_{ist} = \frac{(y_{ijst} + y_{iist}) * p_{ist}(1-\sigma)}{L_{is}w_{ist}}$$

I find a ϕ_{ist} that satisfies (13). Rewriting (13) gives us

$$\phi_{ist} = (\frac{H_{ist}(1-\mu_{ist}) - l_{ist}}{c_{it}})^{\frac{1}{\theta}} \frac{w_{ist}}{P_{it}}$$

which is an expression in terms of known values and ϕ_{ist}.

4.4 Solving the Model

In the previous section, I discussed how to use equilibrium conditions to infer parameter values from data. Here, given the parameter values, I solve the model and reverse–engineer data values. Then I perform counterfactual exercises by holding certain parameters constant and observing any resultant changes in the equilibrium outcomes.

I start with an initial steady–state which I will take as the economy in the first quarter of 2006. Given durables investment, aggregation of durables and prices at that time as well as the calibrated χ and ψ parameters, the capital accumulation equation gives us (nominal) durable goods consumption in the second quarter of 2006.

The bulk of the program consists of a function to find prices. I use a Newton's method equation solver to find the roots of a function that takes eight origin–level prices as inputs. The knowledge of those prices enables us to get, among other equilibrium allocations, real US imports and exports. I start with the function argument and use the price index formula (10) to get sector–level prices. ω_{is}, Ω_{is} and τ_{st}, the parameters that appear in (10), were all calibrated in section 4.2.

The price function nests another function that takes as its argument real aggregation in nondurable goods and, given the durable goods aggregation I have already solved for, identifies the value of nondurable goods aggregation that fulfills the second–stage market clearing condition. I start by backing out y_{i3t} and y_{i4t} using the calibrated η parameters and the first–order conditions (11). Then I obtain the country–level price indices P_{1t} and P_{2t} using (2).

$$P_{it}y_{it} = \sum_{s=1}^{4} P_{ist}y_{ist}$$

$$y_{it} = \prod_{s=1}^{4} (\frac{Y_{ist}}{\eta_{ist}P_{ist}})^{\eta_{ist}}$$

$$\Rightarrow P_{it} = \frac{\sum\limits_{s=1}^{4} P_{ist}y_{ist}}{\prod_{s=1}^{4} (\frac{Y_{ist}}{\eta_{ist}P_{ist}})^{\eta_{ist}}}$$

I obtain wages as a function of prices using (22), as with the calibration.
Next, I need to get output allocations for both imports and exports. These are necessary to find the consumption and composite intermediate goods that go into the second–stage market clearing condition.

Putting (9) into the price equation:

$$\begin{aligned} P_{ist} y_{ist} &= p_{Hst} y_{Hst} + p_{Fst} y_{Fst} \\ &= p_{Fst}^{\gamma} (\frac{\tau_{st}}{p_{Hst}})^{\gamma-1} y_{Fst} + p_{Fst} y_{Fst} \\ \Rightarrow y_{Fst} &= \frac{y_{ist}}{p_{Fst}^{\gamma} (\frac{\tau_{st}}{p_{Hst}})^{\gamma-1} + p_{Fst}} \end{aligned}$$

This equation allows us to get y_{Fst} and y_{Hst} for each sector and country. I combine exports and production for the domestic market in each sector and country to get total production, which lets me find intermediate inputs and labor using the same equations I presented in the calibration section.
The final piece of the second–stage market clearing condition is consumption. There are two equivalent expressions for consumption, one of which I use here and another which will be relevant shortly. In the context of the function that solves for $\{y_{12t}, y_{22t}\}$, I use an expression of consumption that comes from (13):

$$c_{it} = (\frac{w_{ist}}{\phi_{ist} P_{it}})^{\theta} (\frac{H_{ist}(1 - \mu_{ist}) - l_{ist}}{c_{it}}) \tag{23}$$

I end up with expressions for each component of the second–stage market clearing condition that are in terms of prices, y_{i1t} which we got with the capital accumulation equation, and y_{i2t}. I find the values of y_{i2t} that solve the market clearing condition and use them to get labor, consumption, and output (all still as a function of prices).
The final step involves equating two expressions for consumption: (22) and one from (4).

$$(\frac{w_{ist}}{\phi_{ist} P_{it}})^{\theta} (\frac{H_{ist}(1 - \mu_{ist}) - l_{ist}}{c_{it}} = \frac{\sum_{s=1}^{4} w_{ist} l_{ist} + E_{it}}{P_{it}}$$

This yields eight equations with eight unknowns, and I solve the equations to get eight prices.

5 Results

5.1 Goods and Services

Effect allowed to vary	Financial Crisis (Q4 2008–Q2 2009)		Pandemic (Q4 2019–Q2 2020)	
	Goods	Services	Goods	Services
Everything	**-10.85**	**-5.79**	**-12.6**	**-35.1**
Productivity	.0945	-3.43	-.259	-.358
Trade cost	5.04	-.688	2.93	-32.4
Labor endowment shock	-1.85	-1.11	-2.97	-1.04
Disutility of labor	-1.83	-5.99	-5.00	1.28
Consumer preferences	-6.70	-.272	-1.18	-3.12
Investment efficiency	-1.86	1.24	-.259	-.358

Table 5: Correlations between Counterfactual Goods Trade and Baseline Values

Table 5 shows the results of counterfactual experiments where each parameter in turn is the only parameter allowed to change. I compare the percent change in trade over indicated time periods between the "benchmark" model, with all parameters allowed to vary, and six other cases where I only allow one parameter to vary. Trade is simply the sum of real imports and real exports.

Trade frictions, represented by τ, play by far the largest part in explaining movements in services trade during the pandemic. The counterfactual where only trade frictions could vary yielded a 32.4 percent decline in services trade in the first two quarters of 2020, compared with a 35.1 percent decline in services trade in the benchmark model that has all parameters freely moving. None of the other single–parameter counterfactuals even come close. Goods trade, however, does not depend strongly on trade frictions; the model with only trade costs predicts that goods trade would go *up* during the pandemic–induced downturn. Because traded service goods such as tourism and transportation depend so heavily on face–to–face contact, a pandemic that interrupted such contact would have introduced new frictions in trade. The slightly lower goods trade correlation reflects the fact that socially distanced goods trade is slightly easier to perform, and so increased trade frictions were not as devastating to goods industries.

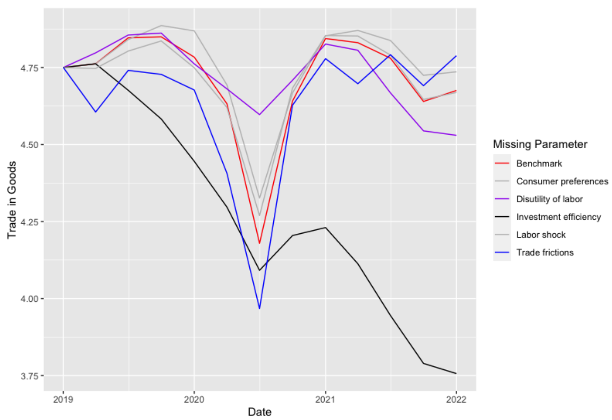
The pandemic and its ensuing lockdowns and border closures could influence trade through two channels: reducing the total stock of time available for agents to divide between labor and leisure and introducing new barriers to trade. The counterfactual experiments displayed in Table 5 indicate that the latter is more important. Services trade fell more than goods trade and recovered more slowly because the pandemic introduced more substantial trade frictions to services than it did to goods.

The disutility of labor parameters influenced goods trade more strongly than trade frictions, with shocks to the labor endowment also playing a sizable role. Causes of an increased disutility of labor in the early months of the pandemic are varied and include risk of infection as well as stimulus checks and generous increases in unemployment benefits. That being said, the disutility of labor still explains less than half of movement in goods trade in early 2020, so causes driving goods trade appear more spread out than factors driving services trade.

In 2008, however, consumer preferences over labor and leisure play a stronger role explaining observed trade patterns than trade frictions. Services trade can mostly be explained by the disutility of labor; if only this parameter were to vary, services trade would fall 5.79 percent between the fourth quarter of 2008 and the second quarter of 2009. Amidst harsh economic conditions, service workers decided to retire from the labor force or work fewer hours, and this dynamic affected heavily–traded service sectors more than heavily–traded goods sectors. Goods trade, perhaps due to its larger size, cannot be explained as convincingly by a single economic factor, but the consumer preference parameter has the largest contribution with a 6.7 percent fall in goods trade compared with a 10.85 percent fall in goods trade in the benchmark case. I hypothesize that a powerful factor behind movements in goods trade was the documented decline in consumer tastes for durable goods, a heavily–traded sector. Eaton et al. (2016) also come to this conclusion.

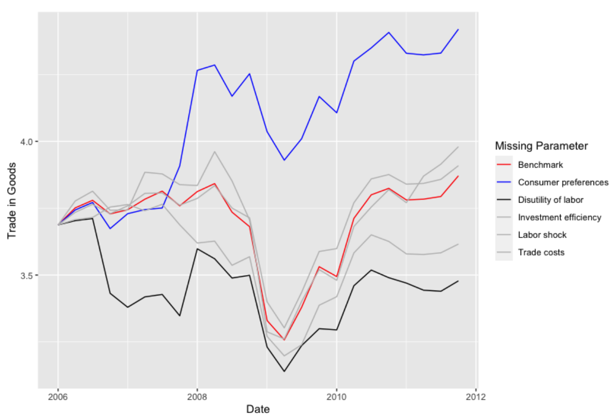
This table tells us that trade frictions overwhelmingly explain the decline in services trade observed in the early months of the pandemic, while preferences over consumption and leisure explain the decline in trade observed in the first two quarters of 2009. In addition, since services trade is smaller in magnitude and less well–established than goods trade, patterns in services trade are more likely to be driven by a single factor than movements in goods trade.

Looking at point estimates of the two downturns can only provide us with so much insight. I next take a step back and perform the opposite experiment to that depicted in Table 5. I look at a time period of several years, and I allow all parameters to vary freely except for one parameter which I hold constant. If a time series closely resembles the benchmark case, the relevant parameter does not play a large role in explaining trade results. Figure 9 displays results from these experiments.



(a) Pandemic Goods Trade

(b) Pandemic Services Trade



(c) Financial Crisis Goods Trade

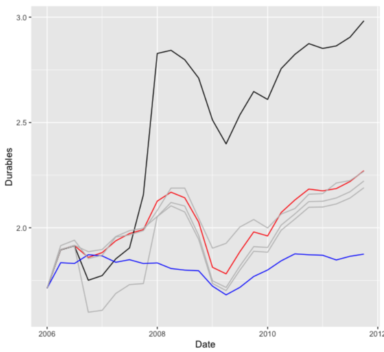
(d) Financial Crisis Services Trade

Figure 9: Counterfactual Trade

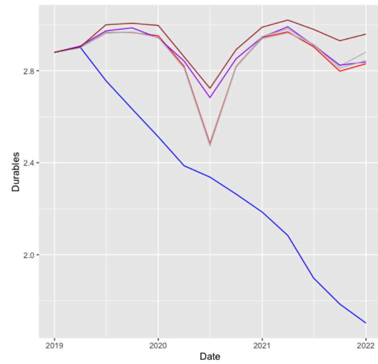
In Figure 9b), each counterfactual time series closely resembles the benchmark case except for the counterfactual with trade costs held constant, implying that without increases in trade frictions services trade would have fallen much less and recovered more quickly. This finding corroborates the conclusion drawn by examining Table 5. Figure 9a), unlike Table 5, also suggests a decent role for trade frictions in goods trade, but this time in the absence of trade cost changes trade would have been lower. With the disutility of labor held constant, on the other hand, the 2020 contraction in goods trade would have been less severe. Furthermore, without changes in durable goods investment efficiency, trade in goods would never have recovered from the pandemic. I hypothesize that a more flexible work structure and more time spent at home allowed consumers to improve their ability to invest in durable goods, and that these changes allowed goods trade to recover from the pandemic faster than it would have otherwise.

Let us turn our attention now to Figures 9c) and 9d), which display counterfactual time series for trade during the financial crisis. Without shifts in consumer preferences, goods trade would have been substantially higher and services trade substantially lower, suggesting that consumers shifted their preferences from goods to services and this behavior explains in large part why services trade performed better than goods trade during the financial crisis. The absence of disutility of labor also altered results, with goods trade having a slower recovery and services trade failing to recover altogether.

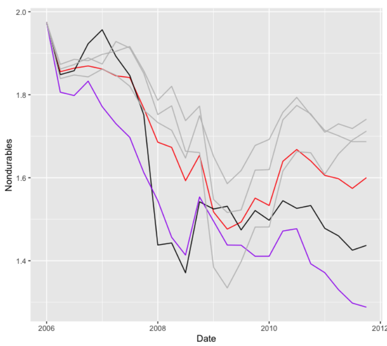
Finally, the omission of trade costs made a difference to financial crisis–era services trade, but not goods trade. As goods trade was more well–established and subject to myriad trade deals (NAFTA, CAFTA, etc.), trade frictions in goods industries would have been less affected by economic shocks than trade frictions in service industries.



(a) Financial Crisis Durable Goods Trade

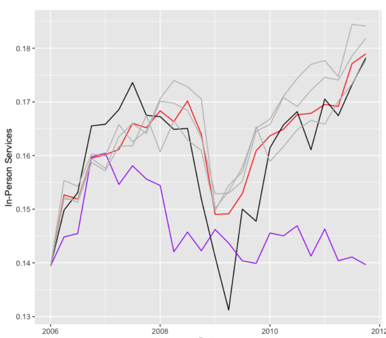


(b) Pandemic Durable Goods Trade

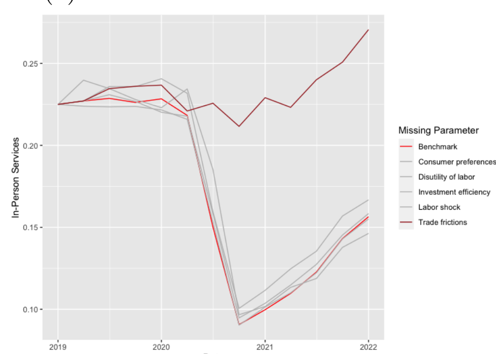


(c) Financial Crisis Nondurable Goods Trade

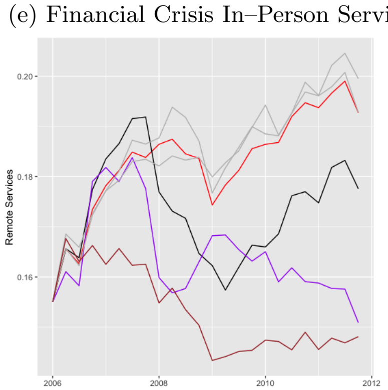
(d) Pandemic Nondurable Goods Trade



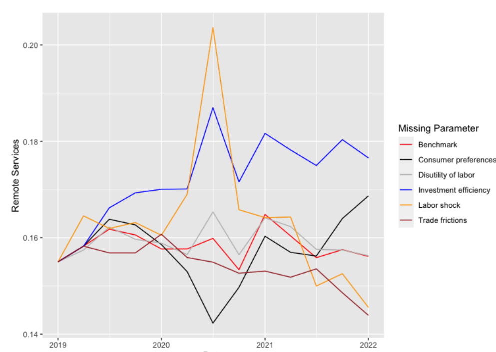
(e) Financial Crisis In–Person Services Trade



(f) Pandemic In–Person Services Trade



(g) Financial Crisis Remote Services Trade



(h) Pandemic Remote Services Trade

Figure 10: Disaggregated Counterfactual Trade

5.2 Disaggregated Goods and Services Trade

Next, I disaggregate goods and services sectors into their constituent components: durable goods and nondurable goods, in–person services and remote services, respectively. I perform the same exercise of holding one parameter constant at a time and observing how the resulting time series differ from our benchmark case. Figure 10 shows results of this exercise.

Durable goods trade during the financial crisis was primarily driven by consumer preferences and investment efficiency. Trade would have been lower without changes in investment efficiency and substantially higher without changes in consumer preferences, implying that U.S. consumers turned their attention away from durable goods but the ability of *investment* in these goods continued to improve. Investment efficiency also played a key role helping durable goods recover from the pandemic, but here the consumer preferences did not matter much. Instead, it looks like durable goods trade would have been slightly higher in the absence of trade friction movement, as the pandemic introduced new trade frictions that the financial crisis did not.

Nondurable goods tell a slightly different story. Trade in nondurable goods would have performed worse without evolution in consumer preferences, as consumers substituted away from durable goods to other types of goods. The disutility of labor also played an important role in aiding the recovery in nondurable goods trade and preventing the downturn from being worse. Surprisingly, during the pandemic, without movement in trade frictions trade in non–durable goods would have been much lower.

Turning our attention to services, for in–person services during the pandemic virtually no parameter mattered but iceberg transportation costs. The observed pandemic decline in imports and exports of services such as tourism was almost entirely due to mechanical difficulties in the trading of those services. During the financial crisis, trade frictions did not play a big role with in–person services trade, but consumer preferences do, as consumers substituted away from durable goods. The purple line indicates that an increased disutility of labor during the downturn and subsequent decrease during the recovery help explain the V–shaped pattern in trade; without it, the V–shape goes away.

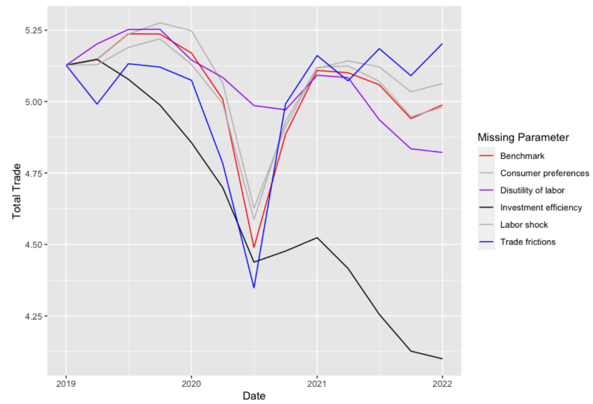
Consumer preferences and the disutility of labor also help explain remote services trade during the financial crisis. We can attribute the slight drop and strong recovery to 1) substitution away from durable goods and 2) consumers' willingness to work. However, the counterfactual without trade costs is substantially different here as well, hinting that trade frictions in remote services were easing during the financial crisis, a phenomenon not observed for in–person services. For pandemic remote services, the most influential factor was shocks to the overall labor endowment; remote services would not have been much affected by trade frictions or a decreased desire to work since agents can perform them easily at home, so the biggest issue to remote services trade would have been issues such as illness that hindered one's ability to be productive.

This analysis corroborates the main conclusions from Section 5.1: namely, that trade frictions were important during the pandemic and preferences over consumption and leisure played the biggest role in explaining trade during the financial crisis. However, a disaggregated look at goods and services trade reveals new insights that were not apparent before. During the financial crisis, consumer preferences for *durable* goods fell, rather than preferences for goods overall. Disutility of labor plays an important role in services trade and nondurable goods trade but not durable goods trade, where the only factors that really mattered are preferences and investment. And during the pandemic period, trade frictions were devastating for in–person services trade and slightly harmful for durable goods trade, but alleviated the extent of the downturn for nondurable goods trade.

5.3 Aggregated Trade

Economists have noted a rather muted trade response to the pandemic crisis as compared to the financial crisis. I aggregate goods and service sectors together to determine which factors were most instrumental in determining overall trade. I present these results in Figure 11.

(a) Financial Crisis Aggregate Trade



(b) Pandemic Aggregate Trade

Figure 11: Counterfactual Aggregate Trade

The main drivers of aggregate trade during the pandemic were investment efficiency and disutility of labor. Without disutility of labor, aggregate trade would have barely declined at all during 2020. Without changes in durable goods investment efficiency, aggregate trade would have been in free–fall over the past few years, suggesting (as does Figure 9a)) that improvements in the efficiency of investing in durable goods has had enormous benefits for the growth of goods trade. Meanwhile, the absence of trade frictions does predict slightly lower trade in 2019 and the first half of 2020, but has no importance afterward.

During the financial crisis, meanwhile, consumer preferences and the disutility of labor have the most predictive power over trade. In the absence of consumer preferences, trade would have been higher, and in the absence of disutility of labor, total trade would have been lower. These two results taken together suggest that trade fell more during the financial crisis due to drastic shifts in preferences away from highly traded sectors. No such fall in preferences for goods occurred in 2020, and improvements in the efficiency of durable goods investment enabled goods trade to recover quickly.

Perhaps the most valuable conclusion to be drawn from this exercise, though, is that we lose nuance when looking at aggregate trade without breaking it down further by sector. As goods trade is around ten times higher than services trade, any aggregate results are impelled by the factors that drive goods trade. We likewise lose nuance when we assume that services are non–tradable or exclude services trade from the calculations altogether.

6 Conclusion

In this study, I use a structural model to examine various causes behind the contrasting trade movements during the financial crisis and the pandemic. My model is dynamic and contains two countries, multiple sectors, and roundabout production. After calibrating the model to match U.S. data in imports, exports, prices and production, I perform counterfactual experiments wherein I isolate some subset of parameters in turn to see which plays the biggest role in explaining trade patterns. I find that trade frictions play the biggest part in explaining trade during the pandemic, while consumer preferences over sectors and leisure play the biggest part in explaining trade during the financial crisis.

These results imply that the primary cause behind recent developments in trade is the difficulty of conducting trade. Any policymaker wishing to revive trade in the wake of an event such as the pandemic should focus on easing trade restrictions, such as through easing border closures, rather than stimulating demand or motivating people to go back to work. Although this model does not explicitly consider inflation, its main result also implies that policymakers wishing to ameliorate inflation might wish to do so through the supply side, by considering ways to lower trade frictions. My results dovetail with some of the findings of earlier work on the financial crisis: namely, that a drop in consumer expenditure on durable goods played a big role in the fall in goods trade, and declines in investment efficiency played a smaller one. However, this study also revealed that disutility of labor played a large part in explaining trade during the financial crisis–the literature has largely not considered elastic labor.

Future research on this topic can go into more detail about the role played by elastic labor decisions in driving changes in trade. In addition, future scholarship could look at whether any of these results change in a model that incorporates inventories or delivery uncertainty. Papers such as Bems et al. (2013) have considered inventories to play a crucial role in trade patterns by exacerbating negative effects of a trade shock, and this model does not contain a mechanism for them.

7 References

Alessandria, G., J. Kaboski and V. Midrigan. 2012. Trade Wedges, Inventories, and Business Cycles. *Journal of Monetary Economics* 60(1): 1–20.

Amiti, M., and D. Weinstein. 2011. Exports and Financial Shocks. *Quarterly Journal of Economics* 126: 1841–77.

Bems, R., R. Johnson, and K. Yi. 2013. The Great Trade Collapse. *Annual Review of Economics* 5: 375–400.

Bonadio, B., Z. Huo, A. Levchenko, and N. Pandalai–Nayar. 2020. *Global Supply Chains in the Pandemic.* NBER Working Papers 27224.

Bussière, M., G. Callegari, F. Ghironi, G. Sestieri, and N. Yamano. 2013. Estimating Trade Elasticities: Demand Composition and the Trade Collpase of 2008–2009. *American Economic Journal: Macroeconomics* 5(3): 118–151.

Cavallo, A., and O. Kryvstsov. 2021. What Can Stockouts Teach Us About Inflation? Evidence from Online Micro Data. *Bank of Canada*: Working Paper.

Chor, D. and K. Manova. 2012. Off the Cliff and Back? Credit Conditions and International Trade during the Global Financial Crisis. *Journal of International Economics* 87: 117–33.

Johnson, R.C., C. Neagu and A. Nicita. 2013. Is Protectionism on the Rise? Assessing National Trade Policies during the Crisis of 2008. *Review of Economics and Statistics* 95(1): 342–346.

Gawande, K., B. Hoekman and Y. Cui. 2011. *Determinants of Trade Policy Responses to the 2008 Financial Crisis.* Policy Res. Work. Pap. 5862, World Bank.

Ha, Jongrim, M.A. Kose, and F. Ohnsorge. 2021. *Inflation during the Pandemic: What Happened? What is Next?* CEPR Discussion Paper No. DP16328.

Jiang, B., D. Rigobon, and R. Rigobon. 2022. From Just–in–Time, to Just–in–Case, to Just–in–*Worst* Case: Simple Models of a Global Supply Chain under Uncertain Aggregate Shocks. *IMF Economic Review* 70: 141–184. LaBelle, J., and A. Santacreu. 2022. Global Supply Chains and Inflation during the Covid–19 Pandemic. *Review–Federal Reserve Bank of St. Louis* 104(2): 1–14.

Levchenko, A., L. Lewis, and L. Tesar. 2010. The Collapse of International Trade during the 2008–2009 Crisis: in Search of the Smoking Gun. *IMF Economic Review* 58(2): 214–253.

Meier, M., and Pinto, E. 2020. Covid–19 supply chain disruptions. *Covid Economics* 48: 139–170.

Paravisini, D., V. Rappoport, P. Schnabl, and D. Wolfenson. 2015. Dissecting the Effect of Credit Supply on Trade: Evidence from Matched Credit–Export Data. *The Review of Economic Studies* 82(1): 333–359.