Trade and the Global Recession

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This Appendix contains the following four sections:

- Appendix Section A describes our data sources and the construction of all variables used in our analysis as well as the data particular to Appendix Figure A.1, which appears below.
- Appendix Section B presents the formulation and solution to the global planner's problem that we use to derive the equilibrium relationships presented in Section 4.4 of the main text.
- Appendix Section C gives the details behind four numerical procedures that we use to back out the shocks and run counterfactuals.
- Appendix Section D discusses how our approach, data, and results relate to those in Levchenko, Lewis, and Tesar (2010).

Appendix Tables A.1-A.18 and Appendix Figures A.1-A.9 appear at the end.

A Data Description

Our analysis involves 21 countries (20 actual countries and Rest of World) across 4 sectors (construction, durable manufactures, nondurable manufactures, and services). Unless otherwise noted, we construct data that are quarterly, seasonally adjusted, and in U.S. dollars.[1] The dataset covers the period 2000:Q1 to 2012:Q4.[2] As discussed in Section 6, for each sector and country, we require data on gross production and gross absorption (in levels) and absorption price indices (in changes). For each manufacturing sector we need data on bilateral trade. For each country we need changes in employment.

A.1 Macro Data

We start by discussing our sources of macro data. Some pieces of these macro data will be needed in the constructing the more intricate sectoral-level data that we turn to next.

A.1.1 National Accounts Data

Quarterly data on nominal GDP and net exports of goods and services are from the Economist Intelligence Unit (EIU).[3] For Rest of World we use annual data from the IMF World Economic Outlook Database assuming a constant quarterly growth rate within the year. Translated into dollars and expressed relative to world consumption, these measures give us the model's measure of GDP $Y_{n,t}$ and the overall deficit $D_{n,t}$ in each country.

We downloaded quarterly seasonally-adjusted data on real GDP from the OECD for all countries except for Romania and China.[4] We denote the change in real GDP as $\hat{y}_{t+1}$ (the ratio of real GDP in $t+1$ to t). These values are used below in constructing data for the services sector. Accumulated changes of real GDP during the recession (2009:Q2/2008:Q3) and during the recovery (2011:Q1/2009:Q2) are plotted in Figure 2(d).

[1] For our measures of trade, production, and prices, we typically start with monthly data and translate to U.S. dollars using exchange rates at the monthly frequency from the OECD.Stat database and from the IMF's International Financial Statistics (IFS) database.

[2] Our full sample of countries does not extend all the way back. We lack sufficient data in France and China prior to 2006. Figures 1 and 4 plot pre-2006 levels of global variables by extending their 2006 levels backwards using quarterly growth rates calculated only using countries that exist in our data for the corresponding two quarter period.

[3] The overall goods and services deficit for India prior to 2005 was available when we first downloaded the data in 2008 but then was removed when we subsequently updated the data. We use these earlier reported deficit values together with the updated Indian deficit data from 2005 onward.

[4] For Romania, we downloaded a non-seasonally adjusted real GDP series from IFS and seasonally adjusted it using the "season_q" command in STATA. For China, we obtained the series from Abeysinghe and Rajaguru (2004).

A.1.2 Labor

Civilian employment data are from the OECD except for China, Finland, and India. For these countries we combine information on the unemployment rate and labor force from EIU to obtain employment. Taking the change across two quarters, these data give us a measure of the labor shocks $\hat{L}_{n,t} = L_{n,t+1}/L_{n,t}$ in the model. The level of employment itself is not used.

A.2 Manufactures

We use the same sources and procedures to generate data for each of the two manufacturing sectors.

A.2.1 Trade

We construct the trade data from monthly observations for each 2-digit harmonized system (HS) category, available from the Global Trade Atlas Database. For each of our 20 actual countries we retain the observations on the value of its total imports, its total exports, and its imports from each of the other 19 actual countries.

Mapping to Industries We aggregate the relevant 2-digit HS categories into durable and nondurable manufactures. First we map the data into 2-digit International Standard Industrial Classification (ISIC Rev. 3) codes. To do so, we start with a concordance of 6-digit HS codes to 2-digit ISIC, available from the World Bank's World Integrated Trade Solution (WITS) website. We then merge this concordance with COMTRADE data on the annual volume of world trade at the 6-digit level for 2007-2008. From this merged dataset we calculate the proportion of world trade in each HS 2-digit category to assign to each 2-digit ISIC category. Finally, we apply a concordance that maps 2-digit ISIC codes into our durable and nondurable manufacturing industries.[5]

Seasonal Adjustment We separately seasonally adjust the monthly data on total imports, total exports, and bilateral imports for each of our two sectors. The reason that we seasonally adjust the trade data is to make them comparable to our measures of monthly manufacturing production, which were more widely available in a seasonally adjusted form. After seasonal adjustment, we aggregate the trade data to quarterly frequency.

[5] Our definition of manufacturing consists of ISIC industries 15 through 36, excluding 23 (petroleum). Table A.1 shows the closely-related mapping from Input-Output industries to our 2 manufacturing sectors (as well as construction and services).

Rest of World We treat Rest of World as a country, thus ignoring bilateral trade between countries within Rest of World. We measure trade between our 20 actual countries and Rest of World as a residual. Each actual country's bilateral imports from Rest of World is the difference between its total imports and its imports from each of the other 19 actual countries. Likewise, Rest of World's imports from each actual country is the difference between that country's total exports and what the other 19 report importing from it. Note that trade involving Rest of World is constructed from seasonally adjusted series, so is not separately seasonally adjusted. Hence bilateral imports of a single country will add up (over its 20 partners) to that country's total imports.[6]

Results If we express the results relative to the value of world consumption, we have our measure of bilateral trade $X^j_{ni,t}$ (country n's imports from i) for each pair of countries $n \neq i$ in each in each quarter t for sectors $j \in \Omega_T = \{D, N\}$. We can add up across countries to get country n's total imports $X^{I,j}_{n,t} = \sum_{i \neq n} X^j_{ni,t}$ and its total exports $X^{E,j}_{n,t} = \sum_{i \neq n} X^j_{in,t}$ in each sector j. Appendix Tables A.15 and A.16 report levels of exports/GDP and imports/GDP for each sector and country in 2008:Q3 and 2009:Q2. The sectoral trade deficit is $D^j_{n,t} = X^{I,j}_{n,t} - X^{E,j}_{n,t}$. In tables and figures, we define the total trade of country n in sector j as $T^j_{n,t} = \left(X^{E,j}_{n,t} + X^{I,j}_{n,t} \right)/2$.

A.2.2 Production

Measuring the value of manufacturing production posed a major challenge for us since data are available only annually for most countries, a frequency that would have limited our ability to evaluate the global recession. Monthly indices of industrial production and prices indicate fluctuations in the value of manufacturing output, but do not contain information about the level. But we require the level to integrate the value of domestic production with the value of international trade (to construct manufacturing absorption, for example). Our solution is to start with the annual value of production, apportioning it within years based on monthly indices of industrial production (IP) and producer price indices (PPI).[7]

We use data for aggregate manufacturing to measure the total value of production in the durables and nondurables sectors. Splitting this total into our two manufacturing sectors required more ingenuity since the same detailed industry series are not available for each of our 20 countries.

[6] Total imports of Rest of World are simply the sum of what each of the 20 actual countries reports exporting to it.

[7] Our basic approach is an application of temporal disaggregation, which was studied from the 1950s by, among others, Milton Friedman (see Friedman, 1962).

Monthly IP and PPI Our source of data on monthly IP and PPI indices for aggregate manufacturing is, with a few exceptions, either the OECD or the EIU. We obtain more detailed industry series from Datastream. We use three different procedures to obtain series for durables and nondurables, applying the procedure separately to IP and PPI.

For a few countries, Datastream reports IP or PPI series on aggregates similar to our durable manufacturing and nondurable manufacturing sectors. For Canada, China, and the United States IP is reported this way while for China and the United States the PPI is reported this way.[8] We use these series directly in our temporal disaggregation procedure described below.

For most of our countries (Austria, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Italy, Romania, South Korea, Spain, Sweden, and the United Kingdom), Datastream reports IP and PPI series for: (i) capital goods, (ii) durable consumer goods, (iii) nondurable consumer goods, and (iv) intermediate goods. Using a regression procedure (described in the next paragraph), we split intermediates between durable intermediates and nondurable intermediates. We use the resulting 5 sectoral series throughout our process of temporal disaggregation. In the end, we construct durables (as the sum of capital goods, durable consumer goods, and durable intermediates) and nondurables (as the sum of nondurable consumer goods and nondurable intermediates).

To split intermediates between durables and nondurables, we take advantage of available IP or PPI series for individual manufacturing industries, available at roughly a 2-digit level. We regress the log of the series for intermediates on the log of the 2-digit industry series. The coefficients from this regression are used to construct the shares of each detailed industry in the index for intermediates.[9] We then construct durable intermediates and nondurable intermediates based on a concordance from the 2-digit industries to durables and nondurables.

For the other countries (India, Japan, Mexico, Poland, and, for the PPI, Canada), we have series only for total manufacturing and for individual industries (again, at roughly a 2-digit level). In these cases we apply the regression procedure described above to the total manufacturing series (rather than to intermediates, as above). We thus construct a measure for durables and nondurables from the available industry series.

Annual Data The annual value of gross manufacturing production for each sector and country are taken from the OECD Structural Analysis Database (STAN) and the United Nations National

[8] For China the series are actually labeled "Heavy Industry" and "Light Industry." The key difference appears to be the treatment of the chemicals industry, which is included in heavy industry while elsewhere we have included it in nondurable manufactures.

[9] We dropped countries from our analysis when the regression analysis described above did not yield a good fit (as judged by a high R-squared and coefficients that sum to close to 1).

Accounts and Industrial Statistics Database (UNIDO). These data are available at the level of 2-digit ISIC industries.[10] We aggregate to the level of durable and nondurable manufactures using the same concordance that we applied to the trade data (the second of the two concordances described above). We also aggregate to the level of (i) capital goods, (ii) durable consumer goods, (iii) nondurable consumer goods, (iv) durable intermediate goods, and (v) nondurable intermediate goods in order to be consistent with data from countries which report at this 5-sector level of aggregation. Finally, as with the monthly data, we retain the data on total manufacturing.

Temporal Disaggregation We exploit our monthly IP and PPI series to disaggregate temporally our annual values of production to a monthly frequency using an adaptation of the Chow-Lin procedure (see Chow and Lin, 1971). We follow Di Fonzo (2003) in treating the relationship between the value of annual production and monthly IP and PPI indices as log-linear rather than linear. We impose unit elasticities so that the value of production rises in proportion to real output and to the price of output.[11] We use the disaggregation procedure to generate a predicted monthly series for the value of production. Generally, there will be a gap between the actual annual value of production and the sum of the 12 predicted monthly values. The procedure apportions this gap equally to each monthly predicted value. The result is an internally consistent monthly series that sums to the actual annual data. A shortcoming is that the resulting series often display artificial jumps from December to January since the residual corrections are identical across months in the same year but different across months in different years. Hence, we follow Fernandez (1981) and redistribute the gap in a way that allows for serial correlation in the monthly residuals, thereby eliminating these jumps. The exact procedure was adapted from the code in Quilis (2006).

We run this procedure for each manufacturing sector separately (either our 2 sectors or the 5 sectors described above), as well as for total manufacturing. In the 5-sector case, we form durables by adding together capital goods, consumer durables, and durable intermediates. We form nondurables by adding together consumer nondurables and nondurable intermediates. To get the sectoral series, we multiply the sector shares (implied by our estimates) by total manufacturing. In the end, we have monthly series for durable and nondurable manufacturing production that are

[10]Occasionally, a 2-digit sector will be dropped for one year. In these cases we interpolate.

[11]As a robustness check, we also estimate these elasticities by regressing annual production levels on the accumulated sum of the monthly indicators. We get similar results using these estimated elasticities in the temporal disaggregation procedure.

consistent with published annual levels of total manufacturing production in each country.[12,13]

Results If we express the results relative to the value of world consumption, we have our measure of production $Y_{n,t}^{j}$ for each country n in each quarter t for each tradable sector $j \in \Omega_T$. In changes, trade $\hat{T}_n^j$ is plotted against production $\hat{Y}_n^j$ for the recession (2009:Q2/2008:Q3) in Figure 2(a) and for the recovery (2011:Q1/2009:Q2) in Figure 2(b).

A.2.3 Absorption and Trade Shares

With trade and production in hand, we obtain absorption as:

$$X_{n,t}^{j} = Y_{n,t}^{j} + X_{n,t}^{I,j} - X_{n,t}^{E,j}.$$

It follows that spending on local producers is:

$$X_{nn,t}^{j} = Y_{n,t}^{j} - X_{n,t}^{E,j}$$

Bilateral trade shares are:

$$\pi_{ni,t}^{j} = X_{ni,t}^{j} / X_{n,t}^{j},$$

for $j \in \Omega_T$. Changes in home shares over the recession and recovery are reported in Appendix Table A.17.

A.2.4 Prices

Using the monthly PPI's that were required for the temporal disaggregation procedure described above, we construct quarterly price indices for durable and nondurable manufactures. We can thus create series of changes, which is what we require for our analysis. Since there is no PPI

[12] Our procedure differs slightly for China. First, we obtain monthly values for total manufacturing production through early 2011 from http://chinadataonline.org, scaling the values proportionately to align with the 2005 manufacturing production total from the input-output tables. We then extrapolate that series through to the end of 2012 using the monthly growth in the product of the IP and PPI indices for China, obtained from the EIU. To split this monthly manufacturing production series into durables and nondurables, we use data on manufacturing production by 4-digit industry from the census of manufacturing production, provided to us by Chang-Tai Hsieh. We used these data to determine the shares of durables and nondurables.

[13] As a check on our procedure we compare our monthly fitted series to actual monthly U.S. Census Bureau data for the values of durable and nondurable manufacturing shipments (the United States is among the few countries with such monthly data). The U.S. monthly data are collected in the M3 manufacturing survey. Though M3 data are available through 2009, we only use data for 1995-2007, using our procedure to extrapolate over the following two years using only the monthly indexes of IP and PPI. Appendix Figure A.9 shows the results. Whether we impose unit elasticities or estimate them (the alternative), we do an excellent job of capturing the out-of-sample decline in production during the global recession.

series for Rest of World, we set price changes there equal to the average of the quarterly changes across our 20 actual countries.

Expressing these changes relative to the change in world consumption spending, we obtain $\hat{p}^{j}_{n,t+1}$ for $j \in \Omega_T$. Changes in prices over the recession and recovery for these two tradable sectors (as well as for the other two sectors, which we turn to next) are reported in Appendix Table A.17.

A.3 Construction

For the construction sector, we measure the value of output each quarter by following a procedure similar to the one used for the manufacturing sectors. As a by-product of this procedure we also obtain a quarterly price series for the construction sector.

A.3.1 Annual Data

For nearly all countries, we obtain the annual nominal local-currency value of construction production from the OECD Sectoral Production data, using industry code "4500" in the years covered by ISIC R.3 and code "4143" for those years covered by ISIC R.4. For China, India, and Romania, which aren't in the OECD data, we use annual construction value added data provided by the UN and scale up using the ratio of value added to output in those countries' input-output tables.[14]

A.3.2 Quarterly Real Series and Price Measures

Quarterly real indices of construction come mostly from the OECD Main Economic Indicators, complemented by Datastream for India, Romania, and South Korea.[15] When only monthly data are available, we aggregate to quarters using the geometric mean across the three months within each quarter. For Japan, we use annual real construction growth obtained from the UN and assume constant quarterly growth rates within the year. Quarterly price measures are generally obtained by comparing growth in these real indicators to growth in quarterly nominal spending in data from Datastream and Eurostat.[16]

[14]Clicking "GDP and its breakdown" at https://unstats.un.org/unsd/snaama/dnlList.asp yields these data.

[15]For the Datastream measures, go to http://stats.oecd.org/, then click Monthly Economic Indicators/Main Economic Indicators/MEI Original release data and revisions/Production in Construction. The Datastream series for Romania and South Korea are "RMESMIX4D" and "KOGDPCOND", respectively. For India, the series "INGDPCZ4C" and "INGDPCONC" are pasted together to cover all the required years.

[16]For Japan, we use the "quick estimate" obtained from http://www.mlit.go.jp/toukeijouhou/chojou/stat-e.htm to measure this nominal spending growth. For Canada and China, we simply evenly allocate annual growth in spending on construction from the UN across quarters in each year.

A.3.3 Temporal Disaggregation

Once we've backed out quarterly changes in real construction activity and the price of construction, we use the annual construction output data and our same temporal disaggregation procedure described above (but at the quarterly level) to generate quarterly spending and price series that are internally consistent and aggregate to the annual totals.

A.3.4 Results

Expressing the value of construction output relative to the value of world consumption spending, we have our measure of $Y^C_{n,t}$. Changes in the construction price index, measured relative to changes in world consumption spending, give us $\hat{p}^C_{n,t}$.

A.4 Services

How we generate data for services relies more on our model.

A.4.1 Trade Deficit

The trade deficit in services is the aggregate imbalance less deficits in the manufacturing sectors:

$$D^S_{n,t} = D_{n,t} - D^D_{n,t} - D^N_{n,t}.$$

Thus, any imbalances in merchandise trade, outside of the manufacturing sector, are included in our measure of the services deficit.

A.4.2 Production of Services

We directly observe nominal GDP $Y_{n,t}$ in each country n. We also observe gross production in the construction and manufacturing sectors $Y^C_{n,t}$, $Y^D_{n,t}$, and $Y^N_{n,t}$. These variables are measured in U.S. dollars. Later, in line with our choice of numéraire, we will scale all such measures each quarter by global household spending (including rental expenditures on household capital) in that quarter.

We do not directly observe gross production in the services sector $Y^S_{n,t}$. To extract $Y^S_{n,t}$ from these observables, we start with the definition of GDP as value added of production in all sectors plus the rental value of household structures:

$$Y_{n,t} = \beta^{V,C}_n Y^C_{n,t} + \beta^{V,D}_n Y^D_{n,t} + \beta^{V,N}_n Y^N_{n,t} + \beta^{V,S}_n Y^S_{n,t} + \frac{\psi^C}{1 - \psi^C - \psi^D} \left(X^{F,N}_{n,t} + X^{F,S}_{n,t} \right),$$

where $\beta_n^{V,j} = \beta_n^{L,j} + \beta_n^{K,jC} + \beta_n^{K,jD}$ is the value-added share of gross production.[17] Rearranging, we get:

$$Y_{n,t}^S = \frac{1}{\beta_n^{V,S}} \left(Y_{n,t} - \frac{\psi^C}{1 - \psi^C - \psi^D} \left(X_{n,t}^{F,N} + X_{n,t}^{F,S} \right) - \beta_n^{V,C} Y_{n,t}^C - \beta_n^{V,D} Y_{n,t}^D - \beta_n^{V,N} Y_{n,t}^N \right).$$

We aren't done, however, because we do not observe $X_{n,t}^{F,N}$ or $X_{n,t}^{F,S}$. They are determined by the relationships:

$$X_{n,t}^{F,h} = Y_{n,t}^h + D_{n,t}^h - \beta_n^{M,Ch} Y_{n,t}^C - \beta_n^{M,Dh} Y_{n,t}^D - \beta_n^{M,hh} Y_{n,t}^h - \beta_n^{M,Sh} Y_{n,t}^S,$$

for $h \in \Omega_K^* = \{N, S\}$. Substituting, and letting $\psi = 1 - \psi^C - \psi^D$, we get:

$$\begin{aligned}
& Y_{n,t}^S \left[\frac{\psi^C}{\psi} \left(1 - \beta_n^{M,SN} - \beta_n^{M,SS} \right) + \beta_n^{V,S} \right] \\
= \; & Y_{n,t} - \frac{\psi^C}{\psi} \left(D_{n,t}^N + D_{n,t}^S \right) - \left(\frac{\psi^C}{\psi} \left(1 - \beta_n^{M,NN} - \beta_n^{M,NS} \right) + \beta_n^{V,N} \right) Y_{n,t}^N \\
& + \left(\frac{\psi^C}{\psi} \left(\beta_n^{M,CN} + \beta_n^{M,CS} \right) - \beta_n^{V,C} \right) Y_{n,t}^C + \left(\frac{\psi^C}{\psi} \left(\beta_n^{M,DN} + \beta_n^{M,DS} \right) - \beta_n^{V,D} \right) Y_{n,t}^D.
\end{aligned}$$

All the terms on the right hand side of this expression are observable, so can be used to obtain $Y_{n,t}^S$. With $Y_{n,t}^S$, $D_{n,t}^S$, and both production and absorption in the other three sectors, we can use the input-output relationship equation (12) to obtain the final spending variables $X_{n,t}^{F,j}$ for $j \in \Omega$.

A final issue is that in the derivation of $Y_{n,t}^S$ above we needed values of ψ^C and ψ^D. Yet, our procedure for calibrating those parameters, equation (25), requires final spending $X_{n,t}^{F,j}$ in each sector, which itself requires a value for $Y_{n,t}^S$. We resolve this circularity by iterating to a find a fixed point in the determination of ψ^C and ψ^D jointly with $Y_{n,t}^S$ and the $X_{n,t}^{F,j}$'s.

A.4.3 Price of Services

We start with the definition for GDP used above. The change in real GDP at date $t+1$, denoted $\hat{y}_{n,t+1}$, is GDP at date $t+1$ measured in date t prices relative to GDP at date t. Using $y_{n,t}^j$ and $x_{n,t}^j$ to denote real production and absorption in sector j, we can write real GDP in period $t+1$ as:

$$\hat{y}_{n,t+1} Y_{n,t} = \sum_{j \in \Omega} \beta_n^{V,j} p_{n,t}^{Y,j} y_{n,t+1}^j + \frac{\psi^C}{1 - \psi^C - \psi^D} \left(p_{n,t}^N x_{n,t+1}^{F,N} + p_{n,t}^S x_{n,t+1}^{F,S} \right), \tag{A.1}$$

[17] Here we define GDP based on the production side. Footnote 17 in the text gives the income-side definition.

where, as above, $\beta_n^{V,j}$ is the share of value added in gross production of sector j. Rearranging equation (A.1), we get an expression for the change in services prices:

$$\hat{p}^S_{n,t+1} = \frac{\beta_n^{V,S} Y^S_{n,t+1} + \frac{\psi^C}{1-\psi^C-\psi^D} X^{F,S}_{n,t+1}}{\hat{y}_{n,t+1} Y_{n,t} - \beta_n^{V,C} \frac{Y^C_{n,t+1}}{\hat{p}^C_{n,t+1}} - \beta_n^{V,D} \frac{Y^D_{n,t+1}}{\hat{p}^{Y,D}_{n,t+1}} - \beta_n^{V,N} \frac{Y^N_{n,t+1}}{\hat{p}^{Y,N}_{n,t+1}} - \frac{\psi^C}{1-\psi^C-\psi^D} \frac{X^{F,N}_{n,t+1}}{\hat{p}^N_{n,t+1}}}. \tag{A.2}$$

To bring equation (A.2) to the data, we need expressions for the price of production $p^{Y,j}_{n,t+1}$ in the tradable sectors, $j \in \Omega_T$. Sector j production at $t+1$ valued at date t prices can be written as:

$$\hat{y}^j_{n,t+1} Y^j_{n,t} = \sum_{m=1}^{\mathcal{N}} \frac{X^j_{mn,t+1}}{\hat{p}^j_{m,t+1}}, \tag{A.3}$$

where we've used the property of our model that the price index for sector j goods that country m imports from n is simply the price of sector j goods in country m. Noting that $Y^j_{n,t+1}/\hat{p}^{Y,j}_{n,t+1} = \hat{y}^j_{n,t+1} Y^j_{n,t}$, we re-write (A.2) as:

$$\hat{p}^S_{n,t+1} = \frac{\beta_n^{V,S} Y^S_{n,t+1} + \frac{\psi^C}{1-\psi^C-\psi^D} X^{F,S}_{n,t+1}}{\hat{y}_{n,t+1} Y_{n,t} - \beta_n^{V,C} \frac{Y^C_{n,t+1}}{\hat{p}^C_{n,t+1}} - \beta_n^{V,D} \left(\sum_{m=1}^{\mathcal{N}} \frac{X^D_{mn,t+1}}{\hat{p}^D_{m,t+1}} \right) - \beta_n^{V,N} \left(\sum_{m=1}^{\mathcal{N}} \frac{X^N_{mn,t+1}}{\hat{p}^N_{m,t+1}} \right) - \frac{\psi^C}{1-\psi^C-\psi^D} \frac{X^{F,N}_{n,t+1}}{\hat{p}^N_{n,t+1}}}. \tag{A.4}$$

We can then use quarterly data on growth in real GDP $\hat{y}_{n,t+1}$ for our 20 countries (and use the cross-country median for Rest of World) and back out the implied growth in services prices.

A.5 Aggregate TFP

We can compare the sectoral productivity shocks that we back out using (28) with aggregate measures that others have used. Following Domar (1961), we aggregate our sectoral productivity changes using as weights the ratio of sectoral production to GDP, $Y^j_{n,t}/Y_{n,t}$. These "Domar weights" sum to a value greater than one to account for the fact that productivity gains in a sector are amplified when it's output is used as an input in other sectors. Using this procedure we obtain a measure of aggregate TFP for each country.

We aggregate up to the world level using a country's share of global GDP as the weights. We find that global TFP growth averaged 1.5 percent per year in the period prior to the recession, before declining at an annual rate of 2.3 percent during the three quarters of recession. The subsequent seven quarter recovery had rapid productivity growth of 2.7 percent before returning to historical average growth near the end of our data.

Appendix Figures A.2 and A.3 corroborate that the aggregate productivity that we extract behaves similarly to other measures. Appendix Figure A.2 compares our quarterly aggregate productivity series for the United States with the TFP series for the U.S. business sector in Fernald et al. (2012). The correlation is 0.78, with our measure slightly less volatile. Appendix Figure A.3 compares, across countries and years, our aggregate productivity series with estimates from the OECD for all available overlapping countries. The regression line has a statistically significant slope of 0.73.[18]

[18] The figure and slope estimate exclude South Korea, which is a large outlier in 2008 and 2009 and therefore obscures the plot. The slope remains significant, but drops to 0.52, if we include it.

B Appendix: Solution to the Planner's Problem

From the planner's objective function (4) and her nine sets of constraints, we can write the planner's problem as one of maximizing the Lagrangian:

$$
\begin{aligned}
\mathcal{L} \; = \; & \sum_{n=1}^{\mathcal{N}}\sum_{t=0}^{\infty}\rho^t \Bigg[\omega_n \phi_{n,t}\left(\sum_{j\in\Omega_K^*}\psi_{n,t}^j \ln C_{n,t}^j + \sum_{k\in\Omega_K}\psi^k \ln K_{n,t}^{H,k}\right) \\
& +\lambda_{n,t}^L\left(L_{n,t} - \sum_{j\in\Omega}\int_0^1 L_{n,t}^j(z)dz\right) + \sum_{k\in\Omega_K}\lambda_{n,t}^{K^k}\left(K_{n,t}^k - \sum_{j\in\Omega}\int_0^1 K_{n,t}^{jk}(z)dz - K_{n,t}^{H,k}\right) \\
& +\sum_{j\in\Omega}\int_0^1 \lambda_{n,t}^j(z)\left(a_{n,t}^j(z)\left(\frac{L_{n,t}^j(z)}{\beta_n^{L,j}}\right)^{\beta_n^{L,j}} \prod_{k\in\Omega_K}\left(\frac{K_{n,t}^{jk}(z)}{\beta_n^{K,jk}}\right)^{\beta_n^{K,jk}} \prod_{j'\in\Omega}\left(\frac{M_{n,t}^{jl}(z)}{\beta_n^{M,jj'}}\right)^{\beta_n^{M,jj'}} - y_{n,t}^j(z)\right) dz \\
& +\sum_{j\in\Omega}\int_0^1 \hat{\lambda}_{n,t}^j(z)\left(y_{n,t}^j(z) - \sum_{m=1}^{\mathcal{N}} d_{mn,t}^j x_{mn,t}^j(z)\right) dz \\
& +\sum_{j\in\Omega}\int_0^1 \tilde{\lambda}_{n,t}^j(z)\left(\sum_{i=1}^{\mathcal{N}} x_{ni,t}^j(z) - x_{n,t}^j(z)\right) dz \\
& +\sum_{j\in\Omega}\lambda_{n,t}^j\left(\left(\int_0^1 x_{n,t}^j(z)^{(\sigma-1)/\sigma}dz\right)^{\sigma/(\sigma-1)} - x_{n,t}^j\right) \\
& +\sum_{h\in\Omega_K^*}\tilde{\lambda}_{n,t}^h\left(x_{n,t}^h - \sum_{j\in\Omega}\int_0^1 M_{n,t}^{jh}(z)dz - C_{n,t}^h\right) + \sum_{k\in\Omega_K}\tilde{\lambda}_{n,t}^k\left(x_{n,t}^k - \sum_{j\in\Omega}\int_0^1 M_{n,t}^{jk}(z)dz - I_{n,t}^k\right) \\
& +\sum_{k\in\Omega_K}\lambda_{n,t}^{V^k}\left(\chi_{n,t}^k\left(I_{n,t}^k\right)^{\alpha^k}(K_{n,t}^k)^{1-\alpha^k} + (1-\delta^k)K_{n,t}^k - K_{n,t+1}^k\right) \\
& +\sum_{j\in\Omega}\int_0^1 \bar{\lambda}_{n,t}^j(z)y_{n,t}^j(z)dz + \sum_{j\in\Omega}\sum_{i=1}^{\mathcal{N}}\int_0^1 \bar{\lambda}_{ni,t}^j(z)x_{ni,t}^j(z)dz\Bigg],
\end{aligned}
$$

where each λ is the Lagrange multiplier associated with the corresponding constraint. The constaints include the nine sets listed in Section 4.3 together with non-negativity constraints on the $y_{n,t}^j(z)$'s and the $x_{ni,t}^j(z)$'s. The transversality conditions are:

$$\lim_{t\to\infty}\rho^t \lambda_{n,t}^{V^k} K_{n,t+1}^k = 0,$$

for each $n = 1, ..., \mathcal{N}$ and $k \in \Omega_K$.

We assume that the planner knows the individual efficiencies $a_{n,t}^j(z)$. We exploit our assumption on the distribution (1) of these terms to derive simple sector-level expressions from the solution to the planner's problem.

B.1 Specialization in the Production of Goods

We start by deriving which countries produce each good, and to which other countries they ship it. The first-order condition with respect to shipments $x^j_{ni,t}(z)$ of good z in sector j from country i to n gives:

$$\tilde{\lambda}^j_{n,t}(z) + \bar{\lambda}^j_{ni,t}(z) = \hat{\lambda}^j_{i,t}(z) d^j_{ni,t}. \tag{A.5}$$

We need to consider two possibilities. If $\bar{\lambda}^j_{ni,t}(z) > 0$ then $\tilde{\lambda}^j_{n,t}(z) < \hat{\lambda}^j_{i,t}(z) d^j_{ni,t}$ and $x^j_{ni,t}(z) = 0$, while if $x^j_{ni,t}(z) > 0$ then $\bar{\lambda}^j_{ni,t}(z) = 0$ and $\tilde{\lambda}^j_{n,t}(z) = \hat{\lambda}^j_{i,t}(z) d^j_{ni,t}$. Since country n will obtain this good from somewhere, looking across all source countries i:

$$\tilde{\lambda}^j_{n,t}(z) = \min_i \left\{ \hat{\lambda}^j_{i,t}(z) d^j_{ni,t} \right\}. \tag{A.6}$$

The first-order condition with respect to production $y^j_{n,t}(z)$ of good z in sector j by country n is:

$$\hat{\lambda}^j_{n,t}(z) + \bar{\lambda}^j_{n,t}(z) = \lambda^j_{n,t}(z).$$

Thus $\lambda^j_{i,t}(z) \geq \hat{\lambda}^j_{i,t}(z)$ for all countries i, with equality if $y^j_{i,t}(z) > 0$. Since $x^j_{ni,t}(z) > 0$ implies $y^j_{i,t}(z) > 0$ we can rewrite (A.6) as:

$$\tilde{\lambda}^j_{n,t}(z) = \min_i \left\{ \lambda^j_{i,t}(z) d^j_{ni,t} \right\}. \tag{A.7}$$

Country i produces good z in sector j if and only if it achieves this minimum in some destination n.

B.2 Costs of Producing Goods

Suppose country n does produce good z in sector j so that $y^j_{n,t}(z) > 0$. The first-order conditions for inputs of labor, capital, and intermediates to produce it give us, for each $j \in \Omega$:

$$\lambda^j_{n,t}(z) \beta^{L,j}_n \frac{y^j_{n,t}(z)}{L^j_{n,t}(z)} = \lambda^L_{n,t},$$

$$\lambda^j_{n,t}(z) \beta^{K,jk}_n \frac{y^j_{n,t}(z)}{K^{jk}_{n,t}(z)} = \lambda^{K^k}_{n,t},$$

for $k \in \Omega_K$, and

$$\lambda^j_{n,t}(z) \beta^{M,jj'}_n \frac{y^j_{n,t}(z)}{M^{jj'}_{n,t}(z)} = \lambda^{j'}_{n,t},$$

for $j' \in \Omega$.

We can relate the shadow cost of producing a good to the shadow costs of the inputs used to produce it. Multiplying the production function by the associated shadow value of output, we get:

$$Y_{n,t}^{j}(z) = \lambda_{n,t}^{j}(z) y_{n,t}^{j}(z) = \lambda_{n,t}^{j}(z) a_{n,t}^{j}(z) \left(\frac{L_{n,t}^{j}(z)}{\beta_n^{L,j}} \right)^{\beta_n^{L,j}} \prod_{k \in \Omega_K} \left(\frac{K_{n,t}^{jk}(z)}{\beta_n^{K,jk}} \right)^{\beta_n^{K,jk}} \prod_{j' \in \Omega} \left(\frac{M_{n,t}^{jj'}(z)}{\beta_n^{M,jj'}} \right)^{\beta_n^{M,jj'}} .$$

Inserting the first-order conditions given above for inputs implies:

$$Y_{n,t}^{j}(z) = \lambda_{n,t}^{j}(z) a_{n,t}^{j}(z) \left(\frac{Y_{n,t}^{j}(z)}{\lambda_{n,t}^{L}} \right)^{\beta_n^{L,j}} \prod_{k \in \Omega_K} \left(\frac{Y_{n,t}^{j}(z)}{\lambda_{n,t}^{K^k}} \right)^{\beta_n^{K,jk}} \prod_{j' \in \Omega} \left(\frac{Y_{n,t}^{j}(z)}{\lambda_{n,t}^{j'}} \right)^{\beta_n^{M,jj'}} .$$

Constant returns to scale implies that $Y_{n,t}^{j}(z)$ cancels, giving us the shadow value of good z in sector j in country n:

$$\lambda_{n,t}^{j}(z) = \frac{c_{n,t}^{j}}{a_{n,t}^{j}(z)}, \tag{A.8}$$

where the term:

$$c_{n,t}^{j} = \left(\lambda_{n,t}^{L} \right)^{\beta_n^{L,j}} \prod_{k \in \Omega_K} \left(\lambda_{n,t}^{K^k} \right)^{\beta_n^{K,jk}} \prod_{j' \in \Omega} \left(\lambda_{n,t}^{j'} \right)^{\beta_n^{M,jj'}} , \tag{A.9}$$

bundles the shadow costs of labor, capital, and intermediates in producing any good in sector j in country n. Applying (A.8), allows us to write (A.7) as:

$$\tilde{\lambda}_{n,t}^{j}(z) = \min_{i} \left\{ \frac{c_{i,t}^{j}}{a_{i,t}^{j}(z)} d_{ni,t}^{j} \right\} . \tag{A.10}$$

B.3 Demand for Goods

Now we take the first-order condition with respect to $x_{n,t}^{j}(z)$ to get:

$$\tilde{\lambda}_{n,t}^{j}(z) = \lambda_{n,t}^{j} \left(x_{n,t}^{j} \right)^{1/\sigma} x_{n,t}^{j}(z)^{-1/\sigma}, \tag{A.11}$$

which we can rearrange as:

$$x_{n,t}^{j}(z) = \left(\frac{\tilde{\lambda}_{n,t}^{j}(z)}{\lambda_{n,t}^{j}} \right)^{-\sigma} x_{n,t}^{j}.$$

Letting $X_{n,t}^{j}(z) = \tilde{\lambda}_{n,t}^{j}(z) x_{n,t}^{j}(z)$ and $X_{n,t}^{j} = \lambda_{n,t}^{j} x_{n,t}^{j}$, we obtain:

$$X_{n,t}^{j}(z) = \left(\frac{\tilde{\lambda}_{n,t}^{j}(z)}{\lambda_{n,t}^{j}} \right)^{-(\sigma-1)} X_{n,t}^{j}. \tag{A.12}$$

We can aggregate over the absorption of individual goods using:

$$x_{n,t}^j = \left(\int_0^1 x_{n,t}^j(z)^{(\sigma-1)/\sigma} dz\right)^{\sigma/(\sigma-1)}. \tag{A.13}$$

In combination with (A.12) we get:[19]

$$X_{n,t}^j = \int_0^1 X_{n,t}^j(z) dz. \tag{A.14}$$

Integrating both sides of (A.12) and applying (A.14) we also get:

$$\lambda_{n,t}^j = \left(\int_0^1 \tilde{\lambda}_{n,t}^j(z)^{-(\sigma-1)} dz\right)^{-1/(\sigma-1)}. \tag{A.15}$$

To obtain sharper results for aggregates we will need to exploit our assumption on the distribution of good-level production efficiency.

B.4 International Trade

We now view the problem from the perspective of not knowing the individual realizations of efficiency $a_{n,t}^j(z)$ but only the parameters of the distribution (1) from which they are drawn (which we repeat here for convenience):

$$F_{n,t}^j(a) = \Pr\left[a_{n,t}^j(z) \leq a\right] = \exp\left[-\left(\frac{a}{\gamma A_{n,t}^j}\right)^{-\theta}\right].$$

[19]From (A.12), replacing $X_{n,t}^j$ with $\lambda_{n,t}^j x_{n,t}^j$, we have:

$$\left(\lambda_{n,t}^j\right)^{1/(\sigma-1)} = \left(\frac{X_{n,t}^j(z)}{x_{n,t}^j}\right)^{1/(\sigma-1)} \frac{\tilde{\lambda}_{n,t}^j(z)}{\lambda_{n,t}^j}$$

Multiplying both sides of (A.13) by this expression:

$$x_{n,t}^j \left(\lambda_{n,t}^j\right)^{1/(\sigma-1)} = \left(\int_0^1 \left[x_{n,t}^j(z) \left(\frac{X_{n,t}^j(z)}{x_{n,t}^j}\right)^{1/(\sigma-1)} \frac{\tilde{\lambda}_{n,t}^j(z)}{\lambda_{n,t}^j}\right]^{(\sigma-1)/\sigma} dz\right)^{\sigma/(\sigma-1)},$$

or

$$\left(\lambda_{n,t}^j x_{n,t}^j\right)^{\sigma/(\sigma-1)} = \left(\int_0^1 X_{n,t}^j(z) dz\right)^{\sigma/(\sigma-1)},$$

which delivers our result.

From (A.10), we can derive the probability distribution function $G^j_{n,t}(x)$ of the $\tilde{\lambda}^j_{n,t}(z)$s as:

$$
\begin{aligned}
G^j_{n,t}(x) &= \Pr\left[\tilde{\lambda}^j_{n,t}(z) \leq x\right] = 1 - \Pr\left[\min_i \left\{\frac{c^j_{i,t} d^j_{ni,t}}{a^j_{i,t}(z)}\right\} > x\right] \\
&= 1 - \prod_i \Pr\left[a^j_{i,t}(z) < \frac{c^j_{i,t} d^j_{ni,t}}{x}\right] = 1 - \prod_i \exp\left[-\left(\frac{c^j_{i,t} d^j_{ni,t}}{\gamma A^j_{i,t} x}\right)^{-\theta}\right] \\
&= 1 - e^{-\Phi^j_{n,t}(\gamma x)^\theta},
\end{aligned}
$$

where:

$$
\Phi^j_{n,t} = \sum_{i=1}^{\mathcal{N}} \left(\frac{c^j_{i,t} d^j_{ni,t}}{A^j_{i,t}}\right)^{-\theta}.
$$

We can use this distribution to simplify the integral in (A.15):

$$
\lambda^j_{n,t} = \left(\int_0^\infty x^{-(\sigma-1)} dG^j_{n,t}(x)\right)^{-1/(\sigma-1)} = \left(\Phi^j_{n,t}\right)^{-1/\theta}. \tag{A.16}
$$

This expression for the shadow value of sector j absorption is the same as that for the price index in Eaton and Kortum (2002). Following the derivation there, the fraction of goods for which country i achieves the minimum of (A.10) in country n is:

$$
\pi^j_{ni,t} = \frac{(c^j_{i,t} d_{ni,t}/A^j_{i,t})^{-\theta}}{\Phi^j_{n,t}} = \left(\frac{c^j_{i,t} d_{ni,t}}{A^j_{i,t} \lambda^j_{n,t}}\right)^{-\theta}. \tag{A.17}
$$

We define the shadow value of all deliveries to country n of sector j goods from country i as:

$$
X^j_{ni,t} = \int_0^1 \tilde{\lambda}^j_{n,t}(z) x^j_{ni,t}(z) dz.
$$

Since the distribution of $\tilde{\lambda}^j_{n,t}(z)$ is the same regardless of the country i from which the goods are shipped, as shown in Eaton and Kortum (2002), and the fraction of goods shipped from i is $\pi^j_{ni,t}$:

$$
X^j_{ni,t} = \pi^j_{ni,t} \int_0^1 \tilde{\lambda}^j_{n,t}(z) x^j_{n,t}(z) dz = \pi^j_{ni,t} \int_0^1 X^j_{n,t}(z) dz = \pi^j_{ni,t} X^j_{n,t}.
$$

Integrating over all sector j goods produced in n, we define the value of production as:

$$
Y^j_{n,t} = \int_0^1 Y^j_{n,t}(z) dz.
$$

Summing across destinations, we can connect the value of production and the value of deliveries to each country:

$$Y_{n,t}^{j}=\sum_{m=1}^{\mathcal{N}}X_{mn,t}^{j}=\sum_{m=1}^{\mathcal{N}}\pi_{mn,t}^{j}X_{m,t}^{j}.$$

B.5 Consumption and Investment

The first-order condition for absorption $x_{n,t}^{j}$ of sector $j\in\Omega$ output in country n at date t is simply:

$$\tilde{\lambda}_{n,t}^{j}=\lambda_{n,t}^{j}.$$

Henceforth we drop $\tilde{\lambda}_{n,t}^{j}$ and replace it with $\lambda_{n,t}^{j}$ in the expressions for consumption and investment.

The first-order condition for consumption $C_{n,t}^{h}$ for $h\in\Omega_K^{*}$ can be written as:

$$\lambda_{n,t}^{h}C_{n,t}^{h}=\omega_n\phi_{n,t}\psi_{n,t}^{h},\tag{A.18}$$

while the first-order condition for household capital services $K_{n,t}^{H,k}$ for $k\in\Omega_K$ gives:

$$\lambda_{n,t}^{K^k}K_{n,t}^{H,k}=\omega_n\phi_{n,t}\psi^{k}.\tag{A.19}$$

Turning to investment, the first-order condition for $I_{n,t}^{k}$ for $k\in\Omega_K$ is:

$$\lambda_{n,t}^{V^k}=\frac{\lambda_{n,t}^{k}}{\alpha^k\chi_{n,t}^{k}}\left(\frac{I_{n,t}^{k}}{K_{n,t}^{k}}\right)^{1-\alpha^k}.$$

In combination with the first-order condition for capital $K_{n,t+1}^{k}$:

$$\lambda_{n,t}^{V^k}=\rho\lambda_{n,t+1}^{V^k}\left(\chi_{n,t+1}^{k}\left(1-\alpha^k\right)\left(\frac{I_{n,t+1}^{k}}{K_{n,t+1}^{k}}\right)^{\alpha^k}+\left(1-\delta^k\right)\right)+\rho\lambda_{n,t+1}^{K^k},$$

we get the Euler equation for $k\in\Omega_K$:

$$\frac{\lambda_{n,t}^{k}}{\alpha^k\chi_{n,t}^{k}}\left(\frac{I_{n,t}^{k}}{K_{n,t}^{k}}\right)^{1-\alpha^k}=\rho\frac{\lambda_{n,t+1}^{k}}{\alpha^k\chi_{n,t+1}^{k}}\left(\frac{I_{n,t+1}^{k}}{K_{n,t+1}^{k}}\right)^{1-\alpha^k}\left(\chi_{n,t+1}^{k}\left(1-\alpha^k\right)\left(\frac{I_{n,t+1}^{k}}{K_{n,t+1}^{k}}\right)^{\alpha^k}+\left(1-\delta^k\right)\right)+\rho\lambda_{n,t+1}^{K^k}.\tag{A.20}$$

We have now derived analogs of the equations appearing in Sections 4.4.1 to 4.4.4.

C Numerical Procedures

This section of the Appendix describes how we carry out four distinct numerical tasks. The first is to compute the initial change in capital required for the system (16) through (24) to follow a perfect foresight path to the stationary state. The second is to compute counterfactual changes in capital, which requires solving the equilibrium of the model in the period when news of counterfactual shocks arrives. The third is to compute impulse responses, starting from a stationary state of the model. The fourth is to compute all the outcomes that we require for constructing tables and figures. We run our numerical procedures on a transformed version of the model presented in the main text, reducing the dimensionality of the model by folding the services sector into each other sector $j \in \Omega_S^* = \{C, D, N\}$ (the complement of the services sector). In this Appendix we first discuss this "folding in" of the services sector and then describe each of the four numerical tasks.

C.1 Folding In the Services Sector

To perform this folding in step, for each sector $j \in \Omega_S^*$, we define $\tilde{\beta}_n^{M,jS} = \beta_n^{M,jS}/(1 - \beta_n^{M,SS})$ and introduce the following compound input shares: (i) we add to $\beta_n^{L,j}$ a term to capture sector j's use of labor indirectly through services intermediates to get $\tilde{\beta}_n^{L,j} = \beta_n^{L,j} + \tilde{\beta}_n^{M,jS}\beta_n^{L,S}$, (ii) we add to $\beta_n^{K,jk}$ a term to capture sector j's use of capital of type k indirectly through services intermediates to get $\tilde{\beta}_n^{K,jk} = \beta_n^{K,jk} + \tilde{\beta}_n^{M,jS}\beta_n^{K,Sk}$, and (iii) we add to $\beta_n^{M,jj'}$ a term to capture sector j's use of output from j' indirectly through j's use of services intermediates to get $\tilde{\beta}_n^{M,jj'} = \beta_n^{M,jj'} + \tilde{\beta}_n^{M,jS}\beta_n^{M,Sj'}$.

We fold services productivity into sector j's productivity with the term:

$$T_{n,t}^j = \left(A_{n,t}^S\right)^{\tilde{\beta}_n^{M,jS}} A_{n,t}^j, \tag{A.21}$$

so that the cost of a bundle of inputs, replacing (5), becomes:

$$b_{n,t}^j = w_{n,t}^{\tilde{\beta}_n^{L,j}} \prod_{k \in \Omega_K} \left(r_{n,t}^k\right)^{\tilde{\beta}_n^{K,jk}} \prod_{j' \in \Omega_S^*} \left(p_{n,t}^{j'}\right)^{\tilde{\beta}_n^{M,jj'}}. \tag{A.22}$$

The price index (6) becomes:

$$p_{n,t}^j = \left[\sum_{i=1}^{\mathcal{N}} \left(\frac{b_{i,t}^j d_{ni,t}^j}{T_{i,t}^j}\right)^{-\theta}\right]^{-1/\theta}, \tag{A.23}$$

which, for sector C, reduces to $p^C_{n,t} = b^C_{n,t}/T^C_{n,t}$. The share (7) of country n's spending on sector $l \in \Omega_T$ devoted to goods from i becomes:

$$\pi^l_{ni,t} = \left(\frac{b^l_{i,t} d^l_{ni,t}}{T^l_{i,t} p^l_{n,t}} \right)^{-\theta}. \tag{A.24}$$

Turning to the goods and factor-market clearing conditions, equation (11) remains unchanged:

$$Y^j_{n,t} = \sum_{m=1}^{\mathcal{N}} \pi^j_{mn,t} X^j_{m,t}. \tag{A.25}$$

We can re-write (12) as:

$$X^j_{n,t} = X^{F,j}_{n,t} + \sum_{j' \in \Omega^*_S} \tilde{\beta}^{M,j'j}_n Y^{j'}_{n,t} + \tilde{\beta}^{M,Sj}_n \left(X^{F,S}_{n,t} - D^S_{n,t} \right), \tag{A.26}$$

while (13) becomes:

$$w_{n,t} L_{n,t} = \sum_{j' \in \Omega^*_S} \tilde{\beta}^{L,j'}_n Y^{j'}_{n,t} + \tilde{\beta}^{L,S}_n \left(X^{F,S}_{n,t} - D^S_{n,t} \right), \tag{A.27}$$

and (14) becomes:

$$r^k_{n,t} K^k_{n,t} = \sum_{j' \in \Omega^*_S} \tilde{\beta}^{K,j'k}_n Y^{j'}_{n,t} + \tilde{\beta}^{K,Sk}_n \left(X^{F,S}_{n,t} - D^S_{n,t} \right) + \frac{\psi^k}{1 - \psi^C - \psi^D} \left(X^{F,N}_{n,t} + X^{F,S}_{n,t} \right). \tag{A.28}$$

We can now list the analogs of equation (16) through (24), including those which are unchanged:

1. Changes in trade shares for sectors $l \in \Omega_T$ are given by:

$$\hat{\pi}^l_{ni,t+1} = \left(\frac{\hat{b}^l_{i,t+1} \hat{d}^l_{ni,t+1}}{\hat{T}^l_{i,t+1} \hat{p}^l_{n,t+1}} \right)^{-\theta}, \tag{A.29}$$

   where:

$$\hat{b}^l_{n,t+1} = \left(\hat{w}_{n,t+1} \right)^{\tilde{\beta}^{L,l}_n} \prod_{k \in \Omega_K} \left(\hat{r}^k_{n,t+1} \right)^{\tilde{\beta}^{K,lk}_n} \prod_{j \in \Omega^*_S} \left(\hat{p}^j_{n,t+1} \right)^{\tilde{\beta}^{M,lj}_n}, \tag{A.30}$$

   is the change in the cost of the input bundle.

2. Changes in prices for sectors $j \in \Omega_S^*$ solve:

$$\hat{p}_{n,t+1}^j = \left[\sum_{i=1}^{\mathcal{N}} \pi_{ni,t}^j \left(\frac{\hat{b}_{i,t+1}^j \hat{d}_{ni,t+1}^j}{\hat{T}_{i,t+1}^j} \right)^{-\theta} \right]^{-1/\theta}, \tag{A.31}$$

where, for sector C, we set $\pi_{nn,t}^C = 1$ and $\pi_{ni,t}^C = 0$ for $i \neq n$.

3. Changes in nondurables consumption spending are given by:

$$\hat{X}_{n,t+1}^{F,N} = \hat{\phi}_{n,t+1} \hat{\psi}_{n,t+1}^N. \tag{A.32}$$

4. Changes in services consumption spending are given by:

$$\hat{X}_{n,t+1}^{F,S} = \hat{\phi}_{n,t+1} \hat{\psi}_{n,t+1}^S. \tag{A.33}$$

5. Changes in investment spending for sectors $k \in \Omega_K$ satisfy:

$$\begin{aligned} \frac{1}{\rho} \frac{\hat{K}_{n,t+1}^k}{\hat{K}_{n,t+1}^k - (1-\delta^k)} &= \alpha^k \frac{r_{n,t+1}^k K_{n,t+1}^k}{X_{n,t}^{F,k}} + \\ & \hat{X}_{n,t+1}^{F,k} \left[(1-\alpha^k) + \frac{1}{\hat{\chi}_{n,t+1}^k} \left(\frac{\hat{p}_{n,t+1}^k \hat{K}_{n,t+1}^k}{\hat{X}_{n,t+1}^{F,k}} \right)^{\alpha^k} \frac{(1-\delta^k)}{\hat{K}_{n,t+1}^k - (1-\delta^k)} \right]. \end{aligned} \tag{A.34}$$

6. Changes in wages satisfy:

$$\hat{w}_{n,t+1} \hat{L}_{n,t+1} w_{n,t} L_{n,t} = \sum_{j \in \Omega_S^*} \tilde{\beta}_n^{L,j} Y_{n,t+1}^j + \tilde{\beta}_n^{L,S} \left(X_{n,t+1}^{F,S} - D_{n,t+1}^S \right). \tag{A.35}$$

7. Changes in rental rates for sectors $k \in \Omega_K$ satisfy:

$$\hat{r}_{n,t+1}^k \hat{K}_{n,t+1}^k r_{n,t}^k K_{n,t}^k = \sum_{j \in \Omega_S^*} \tilde{\beta}_n^{K,jk} Y_{n,t+1}^j + \tilde{\beta}_n^{K,Sk} \left(X_{n,t+1}^{F,S} - D_{n,t+1}^S \right) + \frac{\psi^k}{1-\psi^C-\psi^D} \left(X_{n,t+1}^{F,N} + X_{n,t+1}^{F,S} \right). \tag{A.36}$$

8. To update changes in capital stocks:

$$\hat{K}_{n,t+2}^k - (1-\delta^k) = \hat{\chi}_{n,t+1}^k \left(\frac{\hat{X}_{n,t+1}^{F,k}}{\hat{p}_{n,t+1}^k \hat{K}_{n,t+1}^k} \right)^{\alpha^k} \left(\hat{K}_{n,t+1}^k - (1-\delta^k) \right). \tag{A.37}$$

Our procedures are designed to solve (A.29) through (A.37) together with (A.25) and (A.26).

C.2 Solving for Initial Changes in Capital

Consider cutting into a perfect-foresight equilibrium path of the model at some date t^I, knowing $\left\{X^j_{n,t^I}, \pi^j_{ni,t^I}, Y^S_{n,t^I}\right\}$ for $j \in \Omega^*_S$, and all future shocks $\{\hat{\Psi}_{t+1}\}_{t=t^I}^{\infty}$. Here we describe a procedure to compute the initial changes in capital $\hat{K}^k_{n,t^I+1}$ that solve the system (A.29) through (A.37) while leading the economy to its stationary state.

We employ this procedure in three different ways:

1. To compute our baseline path of changes in capital we set $t^I = t^E$ (representing the quarter in which our data end, 2012:Q4). We then use this procedure to compute $\hat{K}^k_{n,t^E+1}$ given data $\left\{X^j_{n,t^E}, \pi^j_{ni,t^E}, Y^S_{n,t^E}\right\}$. We extract $\hat{K}^k_{n,t+1}$ for earlier quarters using equation (26) and the data it requires.

2. To compute our counterfactuals, we set $t^I = t^N$ (representing the quarter in which news of counterfactual shocks arrive, 2008:Q3). We nest this procedure within another (described in the next subsection) which computes the equilibrium at date t^N and hence delivers values $\left\{X^j_{n,t^N}, \pi^j_{ni,t^N}, Y^S_{n,t^N}\right\}$ needed for the procedure here.

3. To compute the impulse responses described in Section 5.3 we set $t^I = t^E$ and run the procedure here to compute the stationary state values $\left\{X^j_n, \pi^j_{ni}, Y^S_n\right\}$. From this starting point, we then proceed as we would for a counterfactual.

Our computational procedure here follows the strategy in Kehoe, Ruhl, and Steinberg (2014). For $k \in \Omega_K$ and $n = 1, ..., \mathcal{N}$, the objective is to choose $\hat{K}^k_{n,t^I+1}$ and paths of changes in gross production $\left\{\hat{Y}^k_{n,t+1}\right\}_{t=t^I}^{t^T-1}$ to minimize squared deviations from the Euler equations (A.34) at each date together with squared deviations of the terminal changes in capital stocks $\hat{K}^k_{n,t^T+1}$ from their stationary-state values of 1. Here t^T is a terminal date. We typically set $t^T = t^I + 150$, large enough so that extending it has little impact on the values we obtain for $\hat{K}^k_{n,t^I+1}$. For computing the levels of variables in a stationary state, the starting point for our impulse responses, we set $t^T = t^I + 1000$ to give the model plenty of time to settle down.

To evaluate the objective function we need to compute the whole system from date t^I to date $t^T - 1$, given $\hat{K}^k_{n,t^I+1}$ and $\left\{\hat{Y}^k_{n,t+1}\right\}_{t=t^I}^{t^T-1}$. We can describe one function evaluation as a series of one-period problems, from t to $t+1$, setting $t = t^I$ in the first of these one-period problems. Each one-period problem involves the following steps, given $\left\{X^j_{n,t}, \pi^j_{ni,t}, Y^S_{n,t}\right\}$:

1. Start from a guess of $\hat{Y}^N_{n,t+1} = 1$ $(n = 1, ..., \mathcal{N})$ or take the values computed in step 7.

2. From (A.35) solve for changes in wages $\hat{w}_{n,t+1}$:

$$w_{n,t}L_{n,t}\hat{w}_{n,t+1}\hat{L}_{n,t+1} = \sum_{j\in\Omega_S^*}\tilde{\beta}_n^{L,j}Y_{n,t}^j\hat{Y}_{n,t+1}^j + \tilde{\beta}_n^{L,S}\left(X_{n,t}^{F,S}\hat{\phi}_{n,t+1}\hat{\psi}_{n,t+1}^S - D_{n,t+1}^S\right).$$

3. From (A.36) solve for changes in rental rates $\hat{r}_{n,t+1}^k$:

$$\begin{aligned} r_{n,t}^k K_{n,t}^k \hat{r}_{n,t+1}^k \hat{K}_{n,t+1}^k &= \sum_{j\in\Omega_S^*}\tilde{\beta}_n^{K,jk}Y_{n,t}^j\hat{Y}_{n,t+1}^j + \tilde{\beta}_n^{K,Sk}\left(X_{n,t}^{F,S}\hat{\phi}_{n,t+1}\hat{\psi}_{n,t+1}^S - D_{n,t+1}^S\right) \\ &+\frac{\psi^k}{1-\psi^C-\psi^D}\hat{\phi}_{n,t+1}\left(X_{n,t}^{F,N}\hat{\psi}_{n,t+1}^N + X_{n,t}^{F,S}\hat{\psi}_{n,t+1}^S\right). \end{aligned}$$

4. Given changes in factor prices, iterate on (A.31) and (A.30) to solve for changes in goods prices $\hat{p}_{n,t+1}^j$:

$$\hat{p}_{n,t+1}^j = \left[\sum_{i=1}^{\mathcal{N}}\pi_{ni,t}^j\left(\frac{\hat{b}_{i,t+1}^j\hat{d}_{ni,t+1}^j}{\hat{T}_{i,t+1}^j}\right)^{-\theta}\right]^{-1/\theta}.$$

5. Given changes in production costs, use (A.29) to solve for changes in bilateral trade shares:

$$\hat{\pi}_{ni,t+1}^j = \left(\frac{\hat{b}_{i,t+1}^j\hat{d}_{ni,t+1}^j}{\hat{T}_{i,t+1}^j\hat{p}_{n,t+1}^j}\right)^{-\theta}.$$

6. Form a matrix of bilateral trade shares for nondurables Π_{t+1}^N at date $t+1$, so that:

$$\left[\left(\Pi_{t+1}^N\right)^T\right]^{-1}\begin{bmatrix} Y_{1,t}^N\hat{Y}_{1,t+1}^N \\ Y_{2,t}^N\hat{Y}_{2,t+1}^N \\ \vdots \\ Y_{\mathcal{N},t}^N\hat{Y}_{\mathcal{N},t+1}^N \end{bmatrix} = \begin{bmatrix} X_{1,t+1}^N \\ X_{2,t+1}^N \\ \vdots \\ X_{\mathcal{N},t+1}^N \end{bmatrix}. \tag{A.38}$$

7. From (A.26), as it applies to nondurables, we have:

$$X_{n,t+1}^N = X_{n,t}^{F,N}\hat{\phi}_{n,t+1}\hat{\psi}_{n,t+1}^N + \sum_{j\in\Omega_S^*}\tilde{\beta}_n^{M,jN}Y_{n,t}^j\hat{Y}_{n,t+1}^j + \tilde{\beta}_n^{M,SN}\left(X_{n,t}^{F,S}\hat{\phi}_{n,t+1}\hat{\psi}_{n,t+1}^S - D_{n,t+1}^S\right).$$

   Substitute this expression into the right hand side of (A.38) to solve for the $\hat{Y}_{n,t+1}^N$. Return to step 1, iterating until the $\hat{Y}_{n,t+1}^N$ stop changing.

8. With the $\hat{Y}_{n,t+1}^N$ in hand, use (A.26), this time for sector C, to solve for $\hat{X}_{n,t+1}^{F,C}$ from:

$$Y_{n,t}^C\hat{Y}_{n,t+1}^C = \hat{X}_{n,t+1}^{F,C}X_{n,t}^{F,C} + \sum_{j\in\Omega_S^*}\tilde{\beta}_n^{M,jC}Y_{n,t}^j\hat{Y}_{n,t+1}^j + \tilde{\beta}_n^{M,SC}\left(X_{n,t}^{F,S}\hat{\phi}_{n,t+1}\hat{\psi}_{n,t+1}^S - D_{n,t+1}^S\right).$$

9. Form a matrix of bilateral trade shares for durables Π_{t+1}^{D} at date $t+1$, so that:

$$\left[\left(\Pi_{t+1}^{D}\right)^{T}\right]^{-1}\begin{bmatrix} Y_{1,t}^{D}\hat{Y}_{1,t+1}^{D} \\ Y_{2,t}^{D}\hat{Y}_{2,t+1}^{D} \\ \vdots \\ Y_{\mathcal{N},t}^{D}\hat{Y}_{\mathcal{N},t+1}^{D} \end{bmatrix} = \begin{bmatrix} X_{1,t+1}^{D} \\ X_{2,t+1}^{D} \\ \vdots \\ X_{\mathcal{N},t+1}^{D} \end{bmatrix}. \tag{A.39}$$

10. From (A.26), as it applies to durables, we have:

$$X_{n,t+1}^{D} = \hat{X}_{n,t+1}^{F,D}X_{n,t}^{F,D} + \sum_{j\in\Omega_S^*}\tilde{\beta}_n^{M,jD}Y_{n,t}^{j}\hat{Y}_{n,t+1}^{j} + \tilde{\beta}_n^{M,SD}\left(X_{n,t}^{F,S}\hat{\phi}_{n,t+1}\hat{\psi}_{n,t+1}^{S} - D_{n,t+1}^{S}\right).$$

   Substitute this expression into the right hand side of (A.39) to solve for the $\hat{X}_{n,t+1}^{F,D}$.

11. Use the calculated $\hat{X}_{n,t+1}^{F,C}$ and $\hat{X}_{n,t+1}^{F,D}$ to evaluate the squared deviations from the Euler equation (A.34).

12. Update the change in capital to $\hat{K}_{n,t+2}^{k}$ using (A.37).

13. If $t < t^T - 1$ proceed to step 1 to solve the model in the following period.

14. If $t = t^T - 1$, evaluate the squared deviations of $\hat{K}_{n,t^T+1}^{k}$ from 1, together with squared deviations from the Euler equation, to complete one function evaluation.

We have programmed this algorithm in MATLAB. One function evaluation together with a calculation of all the associated numerical derivatives takes about 20 minutes. We minimize the objective function using *fsolve*, which takes about 8 to 72 hours to converge, depending on the path of shocks.

C.3 Solving for Initial Counterfactual Changes in Investment

As noted above, our counterfactuals involve a date t^N (2008:Q3) at which agents receive news of counterfactual shocks, $\{\hat{\Psi}_{t+1}^{c}\}_{t=t^N-1}^{\infty}$. At this date the Euler equation (A.34) doesn't hold. Here we describe how to handle that first period.

For the period prior to the news, t^N-1, we have our baseline change in capital $\hat{K}_{n,t^N}^{k}$ and data for $\left\{X_{n,t^N-1}^{j}, \pi_{ni,t^N-1}^{j}, Y_{n,t^N-1}^{S}\right\}$. Our procedure solves for changes in investment spending $\hat{X}_{n,t^N}^{F,k}$, together with $\hat{K}_{n,t^N+1}^{k}$ and $\left\{X_{n,t^N}^{j}, \pi_{ni,t^N}^{j}, Y_{n,t^N}^{S}\right\}$, satisfying the following three conditions:

1. The changes in investment spending satisfy (A.37):

$$\hat{X}^{F,k}_{n,t^N} = \hat{p}^k_{n,t^N} \hat{K}^k_{n,t^N} \left(\frac{\hat{K}^k_{n,t^N+1} - (1-\delta^k)}{\hat{\chi}^k_{n,t^N} \left(\hat{K}^k_{n,t^N} - (1-\delta^k) \right)} \right)^{1/\alpha^k} .$$

2. The solution to (A.29) through (A.33) and (A.35) through (A.37) together with $\hat{X}^{F,k}_{n,t^N}$ generates $\left\{ X^j_{n,t^N}, \pi^j_{ni,t^N}, Y^S_{n,t^N} \right\}$.

3. Given $\left\{ X^j_{n,t^N}, \pi^j_{ni,t^N}, Y^S_{n,t^N} \right\}$ the changes in capital $\hat{K}^k_{n,t^N+1}$ lead the economy to its stationary state.

This procedure thus employs the first of our four procedures starting at $t^I = t^N$ while simultaneously solving the one-period problem at date t^N without invoking the Euler equation.

C.4 Calculating Impulse Responses

Our impulse responses are designed to guide intuition for how the model economy responds to shocks. For these exercises, it was much speedier to work with a four-country world consisting of Germany, Japan, the United States, and an expanded Rest of World.

To avoid outcomes that are influenced by convergence to the stationary state, we start by calculating levels of variables, $\left\{ X^j_n, \pi^j_{ni}, Y^S_n \right\}$, consistent with a stationary state, starting from the last quarter of our data, t^E. We use the first of our four procedures to obtain these values, setting $t^I = t^E$ and $t^T = t^I + 1000$.

We then use the second of our four procedures to carry out counterfactuals involving either a temporary of permanent shock foreseen one quarter in advance.

C.5 Solving for Outcomes Quarter-by-Quarter

In principle, the procedures for calculating the initial change in capital could be used to solve for all the outcomes of the model. In practice, we compute outcomes in STATA using a procedure that calculates the solution one quarter at a time, given initial changes in capital or, for a counterfactual, initial changes in investment spending.

We solve for outcomes in quarter $t+1$, given endogenous variables dated t, shocks dated $t+1$, and changes in capital dated $t+1$. With the $t+1$ solution in hand, we can update all the endogenous variables to date $t+1$ and, using the capital accumulation equation (A.37), we can update changes in capital to date $t+2$. We are then set to use the same procedure to solve for outcomes in quarter $t+2$, and so on. The following procedure describes how to solve for outcomes in $t+1$.

Define an $\mathcal{N} \times 1$ vector of wage changes $\hat{w}_{t+1} = [\hat{w}_{1,t+1}, ..., \hat{w}_{\mathcal{N},t+1}]$ and corresponding vectors of rental rate changes $\hat{r}^k_{t+1} = [\hat{r}^k_{1,t+1}, ..., \hat{r}^k_{\mathcal{N},t+1}]$, for $k \in \Omega_K$. All three can be stacked into a $3\mathcal{N} \times 1$ vector $\omega_{t+1} = [\hat{w}_{t+1}, \hat{r}^C_{t+1}, \hat{r}^D_{t+1}]^T$. We proceed in a series of steps to solve for this vector of factor price changes:

1. Guess a vector of factor price changes, ω^0_{t+1}, and then solve the system of equations (A.31) for changes in prices. Equations (A.29) deliver changes in trade shares. Denoting the levels in $t+1$ by $\pi^j_{ni}(\omega^0_{t+1})$, we form a trade matrix $\Pi^j(\omega^0_{t+1})$, with $\pi^j_{ni}(\omega^0_{t+1})$ in its n'th row and i'th column. We combine the matrices for $j \in \Omega^*_S$ to form:

$$\mathbf{\Pi}(\omega^0_{t+1}) = \begin{bmatrix} \Pi^C(\omega^0_{t+1}) & 0 & \\ 0 & \Pi^D(\omega^0_{t+1}) & \\ & & \Pi^N(\omega^0_{t+1}) \end{bmatrix}.$$

(Since there is no trade in structures $\Pi^C(\omega^0_{t+1})$ is an identity matrix.)

2. Solve for:

$$X^{F,N}_{n,t+1} = X^{F,N}_{n,t} \hat{\phi}_{n,t+1} \hat{\psi}^N_{n,t+1},$$

and

$$X^{F,S}_{n,t+1} = \left(X^{F,N}_{n,t} + X^{F,S}_{n,t} \right) \hat{\phi}_{n,t+1} - X^{F,N}_{n,t+1},$$

and stack these levels in the vectors $\mathbb{X}^{F,N}$ and $\mathbb{X}^{F,S}$. Remember that in admissible counterfactuals, it must be that: $\sum \left(X^{F,N}_{n,t} + X^{F,S}_{n,t} \right) \hat{\phi}_{n,t+1} = 1 - \psi^C - \psi^D$.[20]

3. Given the price changes calculated above, solve for changes in the $\mathcal{N} \times 1$ vectors of final investment spending for $k \in \Omega_K$: $\hat{\mathbb{X}}^{F,k}_{t+1} = \left[\hat{X}^{F,k}_{1,t+1}, ..., \hat{X}^{F,k}_{\mathcal{N},t+1} \right]^T$. If $t+1$ happens to be the quarter in which news arrives, simply take the $\hat{\mathbb{X}}^{F,k}_{t+1}$ as given and proceed to the fourth step. Otherwise, solve for values of investment spending growth that solve the Euler equations (A.34), which itself involves four parts:

   (a) Start by guessing a value for $\mathbb{X}^{F,C}$ and $\mathbb{X}^{F,D}$ to form the matrix:

$$\mathbb{X}^F = \left[\left(\mathbb{X}^{F,C}\right)^T, \left(\mathbb{X}^{F,D}\right)^T, \left(\mathbb{X}^{F,N}\right)^T \right]^T.$$

[20] If necessary, we increase or decrease the values of $\hat{\phi}_{i,t}$ by a common global factor to ensure admissability. This is only an issue in counterfactuals where we are considering shocks for a subset of countries, such as the U.S.-only case. Similarly, when considering shocks for a subset of countries, we scale services deficits using GDP shares to ensure they sum globally to zero.

(b) Use the input-output structure to solve for the vectors of total spending (including spending on intermediates) in each country that are implied by this guess of $\mathbb{X}^F$, which we will denote with a $3\mathcal{N} \times 1$ vector:

$$\mathbb{X} = [X^C_{1,t+1}, ..., X^C_{\mathcal{N},t+1}, X^D_{1,t+1}, ..., X^D_{\mathcal{N},t+1}, X^N_{1,t+1}, ..., X^N_{\mathcal{N},t+1}]^T.$$

Denoting the vector of trade deficits in services by $D^S_{t+1} = [D^S_{1,t+1}, ..., D^S_{\mathcal{N},t+1}]^T$ and stacking equations (A.26) we have:

$$\mathbb{X} = \mathbb{X}^F + \left[\mathbf{\Pi}(\omega^0_{t+1})\tilde{\boldsymbol{\beta}}^M\right]^T \mathbb{X} + \tilde{\boldsymbol{\beta}}^{M,S}\left[\mathbb{X}^{F,S} - D^S_{t+1}\right], \tag{A.40}$$

with

$$\tilde{\boldsymbol{\beta}}^M = \begin{bmatrix} \tilde{\beta}^{M,CC}_1 & 0 & 0 & \tilde{\beta}^{M,CD}_1 & 0 & 0 & \tilde{\beta}^{M,CN}_1 & 0 & 0 \\ 0 & \ddots & 0 & 0 & \ddots & 0 & 0 & \ddots & 0 \\ 0 & 0 & \tilde{\beta}^{M,CC}_{\mathcal{N}} & 0 & 0 & \tilde{\beta}^{M,CD}_{\mathcal{N}} & 0 & 0 & \tilde{\beta}^{M,CN}_{\mathcal{N}} \\ \tilde{\beta}^{M,DC}_1 & 0 & 0 & \tilde{\beta}^{M,DD}_1 & 0 & 0 & \tilde{\beta}^{M,DN}_1 & 0 & 0 \\ 0 & \ddots & 0 & 0 & \ddots & 0 & 0 & \ddots & 0 \\ 0 & 0 & \tilde{\beta}^{M,DC}_{\mathcal{N}} & 0 & 0 & \tilde{\beta}^{M,DD}_{\mathcal{N}} & 0 & 0 & \tilde{\beta}^{M,DN}_{\mathcal{N}} \\ \tilde{\beta}^{M,NC}_1 & 0 & 0 & \tilde{\beta}^{M,ND}_1 & 0 & 0 & \tilde{\beta}^{M,NN}_1 & 0 & 0 \\ 0 & \ddots & 0 & 0 & \ddots & 0 & 0 & \ddots & 0 \\ 0 & 0 & \tilde{\beta}^{M,NC}_{\mathcal{N}} & 0 & 0 & \tilde{\beta}^{M,ND}_{\mathcal{N}} & 0 & 0 & \tilde{\beta}^{M,NN}_{\mathcal{N}} \end{bmatrix},$$

and

$$\tilde{\boldsymbol{\beta}}^{M,S} = \begin{bmatrix} \tilde{\beta}^{M,SC}_1 & 0 & 0 \\ 0 & \ddots & 0 \\ 0 & 0 & \tilde{\beta}^{M,SC}_{\mathcal{N}} \\ \tilde{\beta}^{M,SD}_1 & 0 & 0 \\ 0 & \ddots & 0 \\ 0 & 0 & \tilde{\beta}^{M,SD}_{\mathcal{N}} \\ \tilde{\beta}^{M,SN}_1 & 0 & 0 \\ 0 & \ddots & 0 \\ 0 & 0 & \tilde{\beta}^{M,SN}_{\mathcal{N}} \end{bmatrix}.$$

Finally, solve for $\mathbb{X}$ from (A.40) using matrix algebra:

$$\mathbb{X} = \left(I_{3\mathcal{N}\times 3\mathcal{N}} - \left[\mathbf{\Pi}(\omega^0_{t+1})\tilde{\boldsymbol{\beta}}^M\right]^T\right)^{-1}\left(\mathbb{X}^F + \tilde{\boldsymbol{\beta}}^{M,S}\left[\mathbb{X}^{F,S} - D^S_{t+1}\right]\right). \tag{A.41}$$

(c) Evaluate whether the guess of $\mathbb{X}^F$ and the associated $\mathbb{X}$, given the shocks and trade shares $\mathbf{\Pi}(\omega^0_{t+1})$, satisfy the Euler equations:

$$\frac{\hat{X}^{F,k}_{n,t+1}}{\hat{p}^k_{n,t+1}\hat{K}^k_{n,t+1}} = \left(\frac{\left(\hat{K}^k_{n,t+1} - \left(1-\delta^k\right)\right)\rho\left(1-\alpha^k\right)\hat{X}^{F,k}_{n,t+1} - \hat{K}^k_{n,t+1} + \left(\hat{K}^k_{n,t+1} - \left(1-\delta^k\right)\right)\vartheta^k_{t+1}}{\left(\delta^k - 1\right)\rho\hat{K}^k_{n,t+1}\frac{\hat{p}^k_{n,t+1}}{\hat{\chi}^k_{n,t+1}}}\right)^{\frac{1}{1-\alpha^j}}$$

where ϑ^k_{t+1} is a function of the global spending vector:

$$\vartheta^k_{t+1} = \frac{\alpha^k\rho}{X^{F,k}_{n,t}}\left[\sum_{j\in\Omega^*_S}\tilde{\beta}^{K,jk}_n Y^j_{n,t+1} + \tilde{\beta}^{K,Sk}_n\left(X^{F,S}_{n,t+1} - D^S_{n,t+1}\right) + \frac{\psi^k}{1-\psi^C-\psi^D}\left(X^{F,N}_{n,t+1} + X^{F,S}_{n,t+1}\right)\right],$$

with:

$$Y^j_{i,t+1} = \sum_{n=1}^{\mathcal{N}}\pi^j_{ni}(\omega^0_{t+1})X^j_{n,t+1},$$

where the $X^j_{n,t+1}$ are elements of $\mathbb{X}$.

(d) If the Euler in part (c) does not hold, iterate on $\mathbb{X}^{F,C}$ and $\mathbb{X}^{F,D}$ until it convergences to the solution. Let $\mathbb{X}(\omega^0_{t+1})$ denote the vector of total spending that, together with a corresponding vector of final spending, satisfies the Euler equation in part (c). This solution is, of course, conditional on the initial factor price guess ω^0_{t+1}.

4. In the fourth step, update the vector of factor prices to $\omega^1_{t+1} = [\hat{w}_{t+1}(\omega^0_{t+1}), \hat{r}^C_{t+1}(\omega^0_{t+1}), \hat{r}^D_{t+1}(\omega^0_{t+1})]$. Here, the vector of wage changes, using (A.35), is given by:

$$\hat{w}_{t+1}(\omega^0_{t+1}) = \Lambda^L_t\left(\tilde{\boldsymbol{\beta}}^L\mathbf{\Pi}(\omega^0_{t+1})^T\mathbb{X}(\omega^0_{t+1}) + \tilde{\boldsymbol{\beta}}^{L,S}\left[\mathbb{X}^{F,S}(\omega^0_{t+1}) - D^S_{t+1}\right]\right), \tag{A.42}$$

where:

$$\Lambda^L_t = \begin{bmatrix} w_{1,t}L_{1,t}\hat{L}_{1,t+1} & 0 & 0 \\ 0 & \ddots & 0 \\ 0 & 0 & w_{\mathcal{N},t}L_{\mathcal{N},t}\hat{L}_{\mathcal{N},t+1}\end{bmatrix}^{-1},$$

$$\tilde{\boldsymbol{\beta}}^L = \begin{bmatrix} \tilde{\beta}^{L,C}_1 & 0 & 0 & \tilde{\beta}^{L,D}_1 & 0 & 0 & \tilde{\beta}^{L,N}_1 & 0 & 0 \\ 0 & \ddots & 0 & 0 & \ddots & 0 & 0 & \ddots & 0 \\ 0 & 0 & \tilde{\beta}^{L,C}_{\mathcal{N}} & 0 & 0 & \tilde{\beta}^{L,D}_{\mathcal{N}} & 0 & 0 & \tilde{\beta}^{L,N}_{\mathcal{N}}\end{bmatrix},$$

$$\tilde{\boldsymbol{\beta}}^{L,S} = \begin{bmatrix} \tilde{\beta}^{L,S}_1 & 0 & 0 \\ 0 & \ddots & 0 \\ 0 & 0 & \tilde{\beta}^{L,S}_{\mathcal{N}}\end{bmatrix}.$$

The vectors of rental rate changes, using (A.36), is given by:

$$\hat{r}^k_{t+1}(\omega^0_{t+1}) = \Lambda^{K,k}_t \left(\tilde{\boldsymbol{\beta}}^{K,k} \boldsymbol{\Pi}(\omega^0_{t+1})^T \mathbb{X}(\omega^0_{t+1}) + \tilde{\boldsymbol{\beta}}^{K,Sk} \left[\mathbb{X}^{F,S}(\omega^0_{t+1}) - D^S_{t+1} \right] + \frac{\psi^k \left(\mathbb{X}^{F,N}(\omega^0_{t+1}) + \mathbb{X}^{F,S}(\omega^0_{t+1}) \right)}{1 - \psi^C - \psi^D} \right), \tag{A.43}$$

where:

$$\Lambda^{K,k}_t = \begin{bmatrix} r^k_{1,t} K^k_{1,t} \hat{K}^k_{1,t+1} & 0 & 0 \\ 0 & \ddots & 0 \\ 0 & 0 & r^k_{\mathcal{N},t} K^k_{\mathcal{N},t} \hat{K}^k_{\mathcal{N},t+1} \end{bmatrix}^{-1}.$$

$$\tilde{\boldsymbol{\beta}}^{K,k} = \begin{bmatrix} \tilde{\beta}^{K,Ck}_1 & 0 & 0 & \tilde{\beta}^{K,Dk}_1 & 0 & 0 & \tilde{\beta}^{K,Sk}_1 & 0 & 0 \\ 0 & \ddots & 0 & 0 & \ddots & 0 & 0 & \ddots & 0 \\ 0 & 0 & \tilde{\beta}^{K,Ck}_{\mathcal{N}} & 0 & 0 & \tilde{\beta}^{K,Dk}_{\mathcal{N}} & 0 & 0 & \tilde{\beta}^{K,Sk}_{\mathcal{N}} \end{bmatrix},$$

$$\tilde{\boldsymbol{\beta}}^{K,Sk} = \begin{bmatrix} \tilde{\beta}^{K,Sk}_1 & 0 & 0 \\ 0 & \ddots & 0 \\ 0 & 0 & \tilde{\beta}^{K,Sk}_{\mathcal{N}} \end{bmatrix}.$$

Having calculated ω^1_{t+1}, return to the step one, with ω^0_{t+1} now equal to ω^1_{t+1}. Continue in this manner until ω^1_{t+1} is sufficiently close to ω^0_{t+1}.

In this algorithm we asserted that (A.40) had a solution given by (A.41). To back up that assertion, consider the matrix:

$$\boldsymbol{B} = \boldsymbol{\Pi}(\omega^0_{t+1}) \tilde{\boldsymbol{\beta}}^M,$$

with typical row sum:

$$\sum_{j' \in \Omega^*_S} \sum_{i=1}^{\mathcal{N}} \tilde{\boldsymbol{\beta}}^{M,jj'}_i \pi^j_{ni} = \sum_{i=1}^{\mathcal{N}} \pi^j_{ni} \sum_{j' \in \Omega^*_S} \tilde{\boldsymbol{\beta}}^{M,jj'}_i < \sum_{i=1}^{\mathcal{N}} \pi^j_{ni} = 1.$$

It follows that $\boldsymbol{A} = I_{3\mathcal{N} \times 3\mathcal{N}} - \boldsymbol{B}$ is strictly diagonal dominant. Thus, $\boldsymbol{A}$ has an inverse, and hence so must its transpose:

$$\boldsymbol{A}^T = I_{3\mathcal{N} \times 3\mathcal{N}} - \left[\boldsymbol{\Pi}(\omega^0_{t+1}) \tilde{\boldsymbol{\beta}}^M \right]^T,$$

which appears in (A.41).

D Relation to Levchenko, Lewis, and Tesar (2010)

Footnote 29 of the text relates the implications of our results for U.S. import barriers over the recession to Levchenko, Lewis, and Tesar (2010, henceforth "LLT")'s calculation of the U.S. import "wedge." Here we explore the connection between our analysis and LLT's more deeply. We first show how our specification of import demand can deliver a formulation very similar to LLT's wedge equation. We then show that, using data over LLT's period and using scale variables more like theirs, our methodology delivers very similar estimates of U.S. import wedges.

LLT calculate wedges ε_n in importing country n as the residual from a standard import demand equation in log differences. Adapting our "hat" notation to represent four-quarter changes, $\hat{x}_{t+4} = x_{t+4}/x_t$, we can write their equation as:

$$\varepsilon_{n,t+4} = \ln \hat{x}^I_{n,t+4} - \epsilon \left(\ln \hat{p}_{n,t+4} - \ln \hat{p}^I_{n,t+4}\right) - \ln \hat{x}_{n,t+4}, \tag{A.44}$$

where $\hat{x}^I$ is the change in real imports, $\hat{p}^I$ is the change in the import price index, $\hat{x}$ is the change in overall real demand, and $\hat{p}$ is the change in the price index corresponding to $\hat{x}$. The wedge thus represents the change in imports not accounted for by the change in the relative price of imports (with an elasticity ϵ) or by the change in total demand (with a unit elasticity). By adding and subtracting price terms, wedges can be expressed as:

$$\begin{aligned} \varepsilon_{n,t+4} &= \left(\ln \hat{x}^I_{n,t+4} + \ln \hat{p}^I_{n,t+4}\right) - \ln \hat{p}^I_{n,t+4} - \epsilon \left(\ln \hat{p}_{n,t+4} - \ln \hat{p}^I_{n,t+4}\right) - \left(\ln \hat{x}_{n,t+4} + \ln \hat{p}_{n,t+4}\right) + \ln \hat{p}_{n,t+4} \\ &= \ln \hat{X}^I_{n,t+4} - (\epsilon - 1)\left(\ln \hat{p}_{n,t+4} - \ln \hat{p}^I_{n,t+4}\right) - \ln \hat{X}_{n,t+4}, \end{aligned} \tag{A.45}$$

where $\hat{X}^I$ is spending on imports and $\hat{X}$ is overall spending.

Our framework can deliver a very similar expression. From the bilateral trade equation (16) in the text,

$$\frac{\hat{X}^j_{ni,t+4}}{\hat{X}^j_{n,t+4}} = \hat{\pi}^j_{ni,t+4} = \left(\frac{\hat{c}^j_{i,t+4}\hat{d}^j_{ni,t+4}}{\hat{A}^j_{i,t+4}\hat{p}^j_{n,t+4}}\right)^{-\theta},$$

taking logs and rearranging gives:

$$-\theta \ln \hat{d}^j_{ni,t+4} = \ln \hat{X}^j_{ni,t+4} - \theta \left(\ln \hat{p}^j_{n,t+4} - \left(\ln \hat{c}^j_{i,t+4} - \ln \hat{A}^j_{i,t+4}\right)\right) - \ln \hat{X}^j_{n,t+4}. \tag{A.46}$$

Replacing $\varepsilon_{n,t+4}$ with $-\theta \ln \hat{d}^j_{ni,t+4}$ and $\epsilon - 1$ with θ in equation (A.45) delivers an equation very similar to equation (A.46). Differences are that: (i) LLT consider country n's total imports rather than imports from a single source i. (ii) LLT use an import price index for country n, $\hat{p}^I_{n,t+4}$, rather than our measure of the costs of an individual exporter, $\hat{c}^j_{i,t+4}/\hat{A}^j_{i,t+4}$. (iii) LLT consider total non-oil imports, imports of durables, and imports of consumer goods while we apply our analysis to imports of durable and nondurable manufactures. (iv) LLT use measures of final spending as their spending variables while we use total absorption $\hat{X}^j_{n,t+4}$.

To make our wedge, $-\theta \ln \hat{d}^j_{ni,t+4}$, multilateral we create an import price index:

$$\ln \hat{p}^{I,j}_{n,t+4} = \sum_{i \neq n} \omega^j_{ni,t} \ln \left(\frac{\hat{c}^j_{i,t+4}}{\hat{A}^j_{i,t+4}} \right), \tag{A.47}$$

using exporter shares as weights:

$$\omega^j_{ni,t} = \frac{X^j_{ni,t}}{X^{I,j}_{n,t}}.$$

We can then create a multilateral version of (A.46):

$$-\theta \ln \hat{d}^{I,j}_{n,t+4} = \ln \hat{X}^{I,j}_{n,t+4} - \theta \left(\ln \hat{p}^j_{n,t+4} - \ln \hat{p}^{I,j}_{n,t+4} \right) - \ln \hat{X}^j_{n,t+4}, \tag{A.48}$$

where our change in import prices $\hat{p}^{I,j}_{n,t+4}$ is not measured directly but is constructed according to (A.47) from changes in production costs in each source.[21]

LLT calculate wedges for only $\epsilon = 1.5$ and $\epsilon = 6$. Since equation (A.44) is linear, we simply construct their wedge for $\epsilon = 3$ (i.e. corresponding to our $\theta = 2$) as the average of their two wedges using weights of 2/3 and 1/3.

The top four lines of Table A.18 report the wedges yielded by applying this procedure to LLT's results for three of the categories of imports they consider. The next four lines report the results of applying (A.48) to our own data using the same period as LLT, 2008Q2-2009:Q2, for similar sectors.

The first column of Table A.18 compares our wedges with LLT's using the broadest definition of imports for each, all non-oil goods for LLT and all manufactures for us. LLT use total consumption and investment as their spending measure, and we use the sum of final spending on our four sectors. Both wedges are substantial, with ours more negative than theirs.

The second two columns of Table A.18 look at durables only. Here LLT use total gross durables investment (including residential investment) as their spending measure while we use, alternatively, (i) total final spending on construction and on durable manufactures (column 2) and (ii) absorption of durable manufactures (column 3). The wedges are again similar to each other. Not surprisingly, in either case focusing on what's going on inside durables implies much

[21] Note that this expression for $\hat{p}^{I,j}_n$ excludes changes in bilateral trade frictions, since those are what we are now interpreting as the wedge. We use a superscript "I" in the term $\hat{d}^{I,j}_{n,t+4}$ from (A.48) to clarify that it is constructed a bit differently from the similar term in footnote 28 of the main text.

smaller wedges.

Column 4 shows LLT's results for imports of consumption goods with final consumption the spending variable. Column 5 reports our results for nondurables imports, using total absorption of nondurables as the spending variable. Both are slightly negative and very close to zero.

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Durables (D)

(1)	Wood and products of wood and cork
(2)	Other non-metallic mineral products
(3)	Iron & steel
(4)	Non-ferrous metals
(5)	Fabricated metal products, except machinery & equipment
(6)	Machinery & equipment, nec
(7)	Office, accounting, & computing machinery
(8)	Electrical machinery & apparatus, nec
(9)	Radio, television, & communication equipment
(10)	Medical, precision, & optical instruments
(11)	Motor vehicles, trailers, & semi-trailers
(12)	Building & repairing of ships & boats
(13)	Aircraft & spacecraft
(14)	Railroad equipment & transport equipment nec
(15)	1/2 of Manufacturing nec; recycling (including Furniture)

Nondurables (N)

(1)	Food products, beverages, & tobacco
(2)	Textiles, textile products, leather, & footwear
(3)	Pulp, paper, & paper products
(4)	Chemicals excluding pharmaceuticals
(5)	Pharmaceuticals
(6)	Rubber & plastics products
(7)	1/2 of Manufacturing nec; recycling (including Furniture)

Construction (C)

(1)	Construction

Services and Residual Sectors (S)

(1)	Agriculture, hunting, forestry, and fishing
(2)	Mining and quarrying (energy)
(3)	Mining and quarrying (energy)
(4)	Coke, refined petroleum products, and nuclear fuel
(5)	Production, collection, and distribution of electricity
(6)	Manufacture of gas; distribution of gaseous fuels through mains
(7)	Steam and hot water supply
(8)	Collection, purification, and distribution of water
(9)	Wholesale & retail trade; repairs
(10)	Hotels & restaurants
(11)	Land transport; transport via pipelines
(12)	Air transport
(13)	Water transport
(14)	Supporting and auxiliary transport activities; activities of travel agencies
(15)	Post and telecommunications
(16)	Finance & insurance
(17)	Real estate activities
(18)	Renting of machinery & equipment
(19)	Computer & related activities
(20)	Research & development
(21)	Other business activities
(22)	Public administration & defense; compulsory social security
(23)	Education
(24)	Health & social work
(25)	Other community, social, & personal services
(26)	Private households with employed persons & extra-territorial organizations & bodies

Table A.1: Sector Definitions in the OECD Input-Output Tables

Notes: Authors' classifications of the 48 sectors included in the OECD input-output tables, with one sector ("Manufacturing nec; recycling (including Furniture)") split evenly between durables and nondurables.

		Change $\left(\frac{2009{:}Q2}{2008{:}Q3}\right)$ in Production in Various Counterfactuals								
	Production / World GDP in 2008:Q3 (percent)	**All Shocks (i.e. Data)**	**Trade Friction Shocks** $\left(\hat{d}^j_{ni}\right)$	**Prod. Shocks** $\left(\hat{A}^j_n\right)$	**Inv. Efficy. in Structures Shocks** $\left(\hat{\chi}^C_n\right)$	**Inv. Efficy. in Durables Shocks** $\left(\hat{\chi}^D_n\right)$	**Nondurables Demand Shocks** $\left(\hat{\psi}^N_n\right)$	**Aggregate Demand Shocks** $\left(\hat{\phi}_n\right)$	**Services Deficits Shocks** $\left(D^S_n\right)$	**Labor Supply Shocks** $\left(\hat{L}_n\right)$
World	**61.9**	**0.870**	**0.995**	**1.011**	**1.001**	**0.905**	**0.958**	**0.998**	**0.998**	**0.997**
Austria	0.4	0.824	0.918	1.077	0.983	0.853	0.955	0.987	0.986	0.988
Canada	1.0	0.786	0.950	0.961	1.021	0.902	1.007	1.074	1.031	1.025
China	11.6	1.107	0.984	1.137	0.995	0.998	0.986	0.980	0.991	0.994
Czech Republic	0.4	0.723	0.965	0.870	1.012	0.823	0.957	1.004	0.983	0.982
Denmark	0.2	0.833	1.033	0.932	0.993	0.859	0.937	1.017	1.006	0.981
Finland	0.3	0.731	0.931	0.979	1.007	0.867	0.968	1.003	1.001	0.998
France	2.0	0.819	1.008	0.976	0.992	0.867	0.935	0.995	0.981	0.987
Germany	4.1	0.786	1.000	0.935	0.986	0.865	0.962	0.995	0.981	0.998
Greece	0.2	0.823	1.006	0.978	0.976	0.876	0.915	0.971	0.984	0.980
India	1.2	1.055	1.023	1.112	0.996	0.930	0.994	1.014	0.977	1.000
Italy	2.6	0.763	0.987	0.976	0.991	0.855	0.932	0.977	0.990	0.988
Japan	5.3	0.875	1.062	0.975	0.975	0.917	0.933	0.936	0.969	0.978
Mexico	1.1	0.763	0.933	0.894	1.023	0.873	0.984	1.059	0.999	1.009
Poland	0.6	0.736	0.809	0.980	1.030	0.835	0.967	1.062	0.988	0.995
Romania	0.2	0.694	0.961	0.878	0.977	0.809	0.927	1.057	1.004	0.983
South Korea	2.2	0.824	0.964	1.025	1.006	0.862	0.967	1.032	0.975	0.999
Spain	1.3	0.774	0.986	1.028	0.981	0.831	0.930	0.990	0.985	0.958
Sweden	0.5	0.711	0.889	0.919	0.992	0.831	0.970	1.044	0.987	0.985
United Kingdom	1.5	0.753	0.954	0.916	1.009	0.877	0.944	1.062	0.991	0.994
United States	8.9	0.861	1.011	1.039	0.984	0.885	0.915	0.967	0.979	0.970
Rest of World	16.3	0.794	1.000	0.973	1.027	0.897	0.974	1.027	1.035	1.024

Table A.2: Production during the Global Recession

Notes: Each column reports the outcome of counterfactuals that include individual shock paths with all other shocks suppressed. The reported effects capture the growth of production during the three quarter recession for each transition path. All values are relative to global GDP.

		Change $\left(\frac{2009{:}Q2}{2008{:}Q3}\right)$ in GDP in Various Counterfactuals								
	GDP / World GDP in 2008:Q3 (percent)	**All Shocks (i.e. Data)**	**Trade Friction Shocks** $\left(\hat{d}^j_{ni}\right)$	**Prod. Shocks** $\left(\hat{A}^j_n\right)$	**Inv. Efficy. in Structures Shocks** $\left(\hat{\chi}^C_n\right)$	**Inv. Efficy. in Durables Shocks** $\left(\hat{\chi}^D_n\right)$	**Nondurables Demand Shocks** $\left(\hat{\psi}^N_n\right)$	**Aggregate Demand Shocks** $\left(\hat{\phi}_n\right)$	**Services Deficits Shocks** $\left(D^S_n\right)$	**Labor Supply Shocks** $\left(\hat{L}_n\right)$
World	**100.0**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**
Austria	0.7	0.979	0.992	1.029	1.006	0.998	1.007	0.995	1.007	1.009
Canada	2.6	0.914	0.965	0.950	0.994	0.985	0.974	0.941	0.977	0.978
China	7.5	1.154	1.003	1.086	1.027	1.029	0.999	1.044	1.004	1.008
Czech Republic	0.4	0.874	1.013	0.985	0.972	0.986	1.015	0.974	1.011	1.016
Denmark	0.6	0.931	1.009	0.985	0.989	1.005	0.999	0.954	0.983	0.998
Finland	0.5	0.920	0.977	0.983	0.993	0.980	1.001	0.991	1.004	1.000
France	4.7	0.979	1.003	0.999	0.991	1.006	1.000	0.973	1.003	1.000
Germany	6.0	0.958	1.007	0.984	1.003	0.983	1.001	0.986	1.009	1.007
Greece	0.6	1.002	1.018	1.012	1.011	1.024	1.017	0.977	1.009	1.012
India	2.1	1.031	0.993	1.018	0.993	0.998	0.981	0.966	1.001	0.987
Italy	3.8	0.974	1.006	0.995	1.001	0.984	1.008	1.004	1.006	1.006
Japan	7.4	1.172	1.040	1.007	1.036	1.019	1.012	1.101	1.021	1.012
Mexico	1.9	0.817	0.976	0.958	0.963	0.986	0.988	0.889	0.993	0.992
Poland	0.9	0.775	0.963	1.039	0.933	0.988	1.006	0.893	1.007	1.013
Romania	0.3	0.830	1.027	0.988	1.043	1.008	1.035	0.904	1.014	1.029
South Korea	1.6	0.939	1.008	1.039	1.016	0.982	1.026	0.994	1.044	1.027
Spain	2.6	0.968	1.008	1.016	1.010	1.004	1.011	0.971	1.008	0.999
Sweden	0.8	0.850	0.975	0.976	0.992	0.982	0.996	0.940	1.001	1.000
United Kingdom	4.5	0.869	0.991	0.973	0.984	1.005	0.999	0.899	1.001	0.997
United States	23.9	1.075	1.015	1.025	1.013	1.022	1.012	1.038	1.014	1.007
Rest of World	26.5	0.925	0.979	0.965	0.980	0.976	0.985	0.979	0.975	0.986

Table A.3: GDP during the Global Recession

Notes: Each column reports the outcome of counterfactuals that include individual shock paths with all other shocks suppressed. The reported effects capture the growth of GDP during the three quarter recession for each transition path. All values are relative to global GDP.

		Change $\left(\frac{2009{:}Q2}{2008{:}Q3}\right)$ in Real GDP Growth Various Counterfactuals								
	GDP / World GDP in 2008:Q3 (percent)	**All Shocks (i.e. Data)**	**Trade Friction Shocks** $\left(\hat{d}^j_{ni}\right)$	**Prod. Shocks** $\left(\hat{A}^j_n\right)$	**Inv. Efficy. in Structures Shocks** $\left(\hat{\chi}^C_n\right)$	**Inv. Efficy. in Durables Shocks** $\left(\hat{\chi}^D_n\right)$	**Nondurables Demand Shocks** $\left(\hat{\psi}^N_n\right)$	**Aggregate Demand Shocks** $\left(\hat{\phi}_n\right)$	**Services Deficits Shocks** $\left(D^S_n\right)$	**Labor Supply Shocks** $\left(\hat{L}_n\right)$
World	**100**	**0.968**	**1.003**	**0.977**	**1.003**	**1.004**	**1.003**	**1.003**	**1.003**	**0.997**
Austria	0.7	0.956	1.002	0.971	1.012	1.011	1.011	1.009	1.012	1.009
Canada	2.6	0.958	0.991	0.980	0.994	0.995	0.993	0.981	0.992	0.986
China	7.5	1.060	0.994	1.059	1.007	1.017	1.001	1.014	1.001	1.002
Czech Republic	0.4	0.942	1.041	0.955	1.002	1.004	1.015	1.001	1.014	1.013
Denmark	0.6	0.943	0.997	0.958	0.999	1.005	1.000	0.987	0.997	0.991
Finland	0.5	0.908	1.005	0.930	1.015	1.010	1.016	1.014	1.017	1.006
France	4.7	0.968	1.002	0.971	0.999	1.002	1.000	0.993	1.000	0.996
Germany	6.0	0.937	1.010	0.939	1.010	1.005	1.010	1.005	1.012	1.012
Greece	0.6	0.967	1.007	0.981	1.006	1.002	1.008	0.995	1.008	1.003
India	2.1	1.045	0.980	1.055	0.988	0.992	0.988	0.989	0.989	0.988
Italy	3.8	0.943	1.009	0.949	1.009	1.002	1.010	1.009	1.010	1.004
Japan	7.4	0.945	0.986	0.943	0.998	1.004	0.997	1.016	0.998	0.993
Mexico	1.9	0.934	1.002	0.957	0.983	0.986	0.987	0.960	0.988	0.989
Poland	0.9	1.013	1.063	1.044	0.992	1.002	1.011	0.972	1.011	1.015
Romania	0.3	0.972	1.062	1.013	1.042	1.018	1.038	0.983	1.033	1.028
South Korea	1.6	0.982	1.054	1.014	1.027	1.007	1.033	1.018	1.037	1.030
Spain	2.6	0.965	1.003	1.002	1.006	1.003	1.006	0.994	1.006	0.977
Sweden	0.8	0.941	1.019	0.958	1.004	1.002	1.004	0.983	1.005	0.998
United Kingdom	4.5	0.960	1.022	0.977	1.005	1.007	1.008	0.976	1.008	1.001
United States	23.9	0.964	0.990	0.976	0.995	1.000	0.994	1.000	0.994	0.979
Rest of World	26.5	0.961	1.013	0.967	1.010	1.008	1.011	1.011	1.009	1.008

Table A.4: Real GDP Growth during the Global Recession

Notes: Each column reports the outcome of counterfactuals that include individual shock paths with all other shocks suppressed. The reported effects capture the growth of real GDP during the three quarter recession for each transition path. Global real GDP growth equals the nominal GDP weighted sum of countries' real GDP growth.

		Change $\left(\frac{2011:Q1}{2009:Q2}\right)$ in Trade in Various Counterfactuals									
	Trade / World GDP in 2009:Q2 (percent)	**All Shocks (i.e. Data)**	**Trade Friction Shocks** $\left(\hat{d}^j_{ni}\right)$	**Prod. Shocks** $\left(\hat{A}^j_n\right)$	**Inv. Efficy. in Structures Shocks** $\left(\hat{\chi}^C_n\right)$	**Inv. Efficy. in Durables Shocks** $\left(\hat{\chi}^D_n\right)$	**Nondurables Demand Shocks** $\left(\hat{\psi}^N_n\right)$	**Aggregate Demand Shocks** $\left(\hat{\phi}_n\right)$	**Services Deficits Shocks** $\left(D^S_n\right)$	**Labor Supply Shocks** $\left(\hat{L}_n\right)$
World	**13.9**	**1.218**	**1.108**	**1.001**	**0.997**	**1.069**	**1.024**	**0.997**	**1.002**	**0.998**
Austria	0.2	1.111	1.091	0.899	1.004	1.034	1.049	1.019	0.999	1.005
Canada	0.4	1.208	1.154	1.008	1.007	1.056	1.008	0.980	1.002	1.007
China	1.5	1.382	1.200	1.063	1.006	1.132	1.029	0.980	1.033	1.009
Czech Republic	0.2	1.258	1.320	0.849	0.998	1.065	1.022	1.020	1.001	0.999
Denmark	0.1	1.012	1.960	0.689	0.990	0.983	1.004	0.998	0.988	0.975
Finland	0.1	1.079	1.004	0.995	0.999	1.060	1.006	1.014	1.002	0.995
France	0.8	1.053	0.991	0.982	0.995	1.025	1.023	1.007	0.998	0.995
Germany	1.5	1.141	1.011	0.989	0.990	1.039	1.019	1.008	0.995	0.992
Greece	0.1	0.724	0.914	1.004	0.911	0.893	1.031	0.932	0.999	0.994
India	0.2	1.468	1.213	1.108	1.008	1.144	1.007	1.010	0.999	0.999
Italy	0.6	1.107	1.030	0.976	0.996	1.037	1.028	1.012	0.998	0.994
Japan	0.7	1.269	1.092	0.994	0.989	1.105	1.031	0.996	1.000	0.989
Mexico	0.3	1.289	1.384	0.902	0.996	1.026	1.026	0.981	1.002	1.004
Poland	0.2	1.184	1.044	1.027	1.000	1.031	1.036	0.995	0.998	0.993
Romania	0.1	1.291	1.257	0.936	0.981	1.034	1.015	1.013	0.988	0.989
South Korea	0.5	1.279	1.077	1.020	1.027	1.171	1.038	1.015	1.038	1.027
Spain	0.4	1.127	1.128	0.956	0.974	1.026	1.034	1.005	1.001	0.991
Sweden	0.2	1.253	1.124	1.019	0.985	1.074	1.006	0.969	0.995	0.988
United Kingdom	0.6	1.183	1.218	0.939	0.992	1.000	0.992	0.995	0.991	0.991
United States	1.7	1.176	1.102	1.001	0.999	1.049	1.030	0.990	1.008	1.002
Rest of World	3.5	1.252	1.074	1.029	0.999	1.087	1.026	0.998	0.992	0.998

Table A.5: Trade during the Recovery

Notes: Each column reports the outcome of counterfactuals that include individual shock paths with all other shocks suppressed. The reported effects capture the growth of trade during the seven quarter recovery for each transition path. All values are relative to global GDP. Trade friction shocks had a particularly large positive effect, and productivity shocks had a particularly large negative effect, on trade in Denmark. The explanation for this anomaly is the large decline in Denmark's home shares in manufacturing. Note how $\hat{\pi}^j_{nn}$ enters equations (27) and (28) to create these effects.

	Production / World GDP **in 2009:Q2** (percent)	**Change $\left(\frac{2011:Q1}{2009:Q2}\right)$ in Production in Various Counterfactuals**								
		All Shocks (i.e. Data)	**Trade Friction Shocks** $\left(\hat{d}_{ni}^{j}\right)$	**Prod. Shocks** $\left(\hat{A}_n^j\right)$	**Inv. Efficy. in Structures Shocks** $(\hat{\chi}_n^C)$	**Inv. Efficy. in Durables Shocks** $(\hat{\chi}_n^D)$	**Nondurables Demand Shocks** $\left(\hat{\psi}_n^N\right)$	**Aggregate Demand Shocks** $\left(\hat{\phi}_n\right)$	**Services Deficits Shocks** (D_n^S)	**Labor Supply Shocks** $\left(\hat{L}_n\right)$
World	**53.9**	**1.167**	**1.017**	**1.013**	**1.003**	**1.081**	**1.033**	**0.999**	**0.997**	**0.997**
Austria	0.3	1.053	1.047	0.865	1.016	1.068	1.065	1.041	1.008	1.019
Canada	0.8	1.126	1.119	1.021	0.990	1.048	0.991	0.933	0.991	1.006
China	12.8	1.260	1.070	1.063	1.016	1.162	1.022	0.988	1.022	1.003
Czech Republic	0.3	1.117	1.277	0.785	1.001	1.066	1.036	1.040	1.010	1.007
Denmark	0.2	0.886	1.981	0.482	0.991	1.025	0.998	1.002	0.974	0.952
Finland	0.2	0.998	0.924	0.972	1.018	1.055	1.011	1.040	1.014	1.001
France	1.6	0.980	0.889	0.944	0.993	1.026	1.018	1.013	0.994	0.985
Germany	3.2	1.098	0.931	0.982	0.987	1.030	1.015	1.021	0.998	0.989
Greece	0.1	0.890	0.918	0.962	1.008	0.937	1.053	1.033	1.001	0.977
India	1.3	1.327	1.092	1.146	0.982	1.108	0.964	0.939	0.988	0.980
Italy	2.0	0.999	0.922	0.938	1.001	1.026	1.032	1.025	1.003	0.992
Japan	4.7	1.164	1.024	0.967	0.991	1.073	1.059	0.998	1.000	0.985
Mexico	0.8	1.164	1.245	0.885	0.972	0.999	1.030	0.947	0.979	0.989
Poland	0.5	1.168	1.060	1.077	0.978	1.025	1.065	0.986	1.001	0.993
Romania	0.1	1.110	1.218	0.861	1.089	1.065	1.098	1.071	1.026	1.050
South Korea	1.8	1.297	1.124	1.019	1.050	1.186	1.062	1.030	1.067	1.055
Spain	1.0	0.960	0.962	0.876	1.021	1.029	1.048	1.022	1.006	0.980
Sweden	0.3	1.286	1.155	1.058	0.967	1.059	1.001	0.932	0.997	0.983
United Kingdom	1.2	0.973	1.061	0.804	1.009	1.018	0.981	1.000	0.991	0.987
United States	7.6	1.020	0.949	0.923	0.997	1.026	1.034	1.015	0.988	0.976
Rest of World	13.0	1.242	1.012	1.109	1.004	1.089	1.044	0.989	0.978	1.009

Table A.6: Production during the Recovery

Notes: Each column reports the outcome of counterfactuals that include individual shock paths with all other shocks suppressed. The reported effects capture the growth of production during the seven quarter recovery for each transition path. All values are relative to global GDP.

	GDP / World GDP in 2009:Q2 (percent)	All Shocks (i.e. Data)	Trade Friction Shocks $\left(\hat{d}^j_{ni}\right)$	Prod. Shocks $\left(\hat{A}^j_n\right)$	Inv. Efficy. in Structures Shocks $\left(\hat{\chi}^C_n\right)$	Inv. Efficy. in Durables Shocks $\left(\hat{\chi}^D_n\right)$	Nondurables Demand Shocks $\left(\hat{\psi}^N_n\right)$	Aggregate Demand Shocks $\left(\hat{\phi}_n\right)$	Services Deficits Shocks $\left(D^S_n\right)$	Labor Supply Shocks $\left(\hat{L}_n\right)$
		Change $\left(\frac{2011:Q1}{2009:Q2}\right)$ in GDP in Various Counterfactuals								
World	**100.0**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**
Austria	0.7	0.912	0.989	0.939	0.989	0.978	0.983	0.964	0.995	0.992
Canada	2.4	1.107	1.016	1.008	1.011	0.985	1.005	1.071	1.000	1.003
China	8.7	1.164	1.025	1.032	1.009	1.068	0.991	1.052	0.960	0.988
Czech Republic	0.3	0.933	1.073	0.885	0.998	0.977	0.989	0.959	0.991	0.985
Denmark	0.5	0.923	1.159	0.901	0.988	0.978	1.002	0.974	1.000	0.989
Finland	0.4	0.917	0.980	1.007	0.994	1.000	1.014	0.976	1.004	1.006
France	4.6	0.889	0.970	0.979	0.984	0.975	0.995	0.956	0.988	0.994
Germany	5.7	0.925	0.983	1.000	1.006	1.000	1.005	0.966	0.997	1.008
Greece	0.6	0.748	0.973	0.976	0.932	0.957	0.991	0.859	0.997	0.991
India	2.2	1.260	1.016	1.049	1.011	1.007	0.993	1.154	0.971	0.989
Italy	3.7	0.869	0.972	0.970	0.992	0.984	0.999	0.942	0.997	0.998
Japan	8.7	0.986	0.997	0.970	1.014	0.999	0.988	1.000	0.979	0.989
Mexico	1.6	1.085	1.055	0.976	0.998	0.979	0.994	1.062	0.996	0.999
Poland	0.7	1.061	1.004	1.001	1.029	0.972	0.990	1.015	1.001	0.991
Romania	0.3	0.934	1.024	0.938	0.964	0.950	0.987	0.955	1.021	0.987
South Korea	1.5	1.108	1.035	0.988	1.010	1.041	1.006	1.047	0.985	1.009
Spain	2.6	0.844	0.978	0.952	0.942	0.966	0.987	0.945	0.989	0.983
Sweden	0.7	1.137	1.040	1.017	1.016	0.999	1.002	1.063	0.991	1.000
United Kingdom	3.9	0.937	1.009	0.974	0.985	0.980	1.008	0.984	1.002	1.002
United States	25.7	0.890	0.987	0.978	0.989	0.985	0.998	0.951	0.996	0.997
Rest of World	24.5	1.108	1.007	1.044	1.015	1.013	1.009	1.042	1.028	1.012

Table A.7: GDP during the Recovery

Notes: Each column reports the outcome of counterfactuals that include individual shock paths with all other shocks suppressed. The reported effects capture the growth of GDP during the seven quarter recovery for each transition path. All values are relative to global GDP.

	GDP / World GDP in 2009:Q2 (percent)	Change $\left(\frac{2011:Q1}{2009:Q2}\right)$ in Real GDP Growth Various Counterfactuals								
		All Shocks (i.e. Data)	**Trade Friction Shocks** $\left(\hat{d}^j_{ni}\right)$	**Prod. Shocks** $\left(\hat{A}^j_n\right)$	**Inv. Efficy. in Structures Shocks** $\left(\hat{\chi}^C_n\right)$	**Inv. Efficy. in Durables Shocks** $\left(\hat{\chi}^D_n\right)$	**Nondurables Demand Shocks** $\left(\hat{\psi}^N_n\right)$	**Aggregate Demand Shocks** $\left(\hat{\phi}_n\right)$	**Services Deficits Shocks** $\left(D^S_n\right)$	**Labor Supply Shocks** $\left(\hat{L}_n\right)$
World	**100**	**1.062**	**1.021**	**1.067**	**1.007**	**0.993**	**1.007**	**1.006**	**1.008**	**1.006**
Austria	0.7	1.059	1.040	1.065	1.014	0.989	1.015	1.003	1.018	1.022
Canada	2.4	1.063	0.999	1.037	0.997	0.979	0.994	1.013	0.993	1.000
China	8.7	1.182	1.018	1.123	1.014	1.046	1.003	1.023	0.998	1.004
Czech Republic	0.3	1.044	1.089	1.040	1.015	0.979	1.017	1.000	1.017	1.010
Denmark	0.5	1.032	1.060	1.063	0.993	0.972	0.998	0.985	0.997	0.975
Finland	0.4	1.060	1.052	1.104	1.025	0.998	1.034	1.015	1.032	1.026
France	4.6	1.042	1.019	1.058	0.995	0.975	0.997	0.983	0.996	0.997
Germany	5.7	1.080	1.042	1.104	1.017	0.989	1.018	0.999	1.016	1.022
Greece	0.6	0.881	1.016	0.969	0.999	0.967	1.011	0.965	1.013	0.995
India	2.2	1.185	0.974	1.155	0.978	0.987	0.976	1.005	0.972	0.977
Italy	3.7	1.032	1.041	1.065	1.013	0.980	1.017	0.994	1.017	1.012
Japan	8.7	1.034	0.992	1.051	0.994	0.993	0.993	0.994	0.993	0.987
Mexico	1.6	1.096	1.005	1.077	0.972	0.955	0.978	0.995	0.978	0.985
Poland	0.7	1.073	1.034	1.110	1.019	0.968	1.016	1.019	1.020	1.008
Romania	0.3	1.148	1.108	1.192	1.052	0.974	1.055	1.028	1.063	1.049
South Korea	1.5	1.106	1.058	1.104	1.053	1.036	1.057	1.065	1.053	1.065
Spain	2.6	1.000	1.036	1.041	1.000	0.974	1.006	0.988	1.007	0.987
Sweden	0.7	1.084	1.009	1.090	1.007	0.984	1.007	1.030	1.005	1.007
United Kingdom	3.9	1.030	1.041	1.049	1.009	0.985	1.015	1.002	1.014	1.013
United States	25.7	1.037	0.997	1.058	0.987	0.974	0.987	0.974	0.988	0.978
Rest of World	24.5	1.054	1.041	1.054	1.030	1.010	1.030	1.040	1.033	1.035

Table A.8: Real GDP Growth during the Global Recovery

Notes: Each column reports the outcome of counterfactuals that include individual shock paths with all other shocks suppressed. The reported effects capture the growth of real GDP during the three quarter recession for each transition path. Global real GDP growth equals the nominal GDP weighted sum of countries' real GDP growth.

	Trade / World GDP in 2008:Q3 (percent)	Change $\left(\frac{2009:Q2}{2008:Q3}\right)$ in Trade in Various Counterfactuals								
		All Shocks (i.e. Data)	**Trade Friction Shocks** $\left(\hat{d}^j_{ni}\right)$	**Prod. Shocks** $\left(\hat{A}^j_n\right)$	**Inv. Efficy. in Structures Shocks** $\left(\hat{\chi}^C_n\right)$	**Inv. Efficy. in Durables Shocks** $\left(\hat{\chi}^D_n\right)$	**Nondurables Demand Shocks** $\left(\hat{\psi}^N_n\right)$	**Aggregate Demand Shocks** $\left(\hat{\phi}_n\right)$	**Services Deficits Shocks** $\left(D^S_n\right)$	**Labor Supply Shocks** $\left(\hat{L}_n\right)$
World	**17.5**	**0.795**	**0.965**	**1.014**	**0.996**	**0.866**	**0.964**	**0.996**	**0.997**	**0.996**
Austria	0.3	0.790	0.865	1.104	0.992	0.870	0.965	0.992	0.994	0.995
Canada	0.5	0.752	0.878	1.029	1.016	0.863	0.982	1.009	1.004	1.001
China	1.8	0.852	0.903	1.077	1.000	0.929	0.975	0.997	0.997	0.997
Czech Republic	0.2	0.746	1.067	0.918	0.983	0.806	0.973	0.994	0.994	0.994
Denmark	0.2	0.805	0.996	1.011	0.990	0.863	0.952	0.993	1.000	0.997
Finland	0.1	0.675	0.840	1.017	0.991	0.835	0.967	0.996	0.996	0.993
France	0.9	0.828	1.035	0.988	0.994	0.869	0.957	0.993	0.999	0.998
Germany	1.9	0.784	0.982	0.989	0.992	0.850	0.965	0.993	0.994	0.996
Greece	0.1	0.834	1.042	0.985	0.996	0.889	0.952	0.975	1.000	0.999
India	0.3	0.831	0.871	1.099	1.008	0.915	0.983	1.013	0.999	1.004
Italy	0.8	0.770	0.985	0.994	0.994	0.845	0.950	0.991	0.997	0.995
Japan	0.9	0.773	0.888	1.024	0.996	0.894	0.964	0.989	0.990	0.991
Mexico	0.4	0.774	1.058	0.972	0.991	0.812	0.989	1.000	1.003	1.002
Poland	0.3	0.758	1.078	0.980	0.963	0.803	0.976	0.988	0.996	0.998
Romania	0.1	0.719	1.105	0.952	0.999	0.754	0.954	0.969	0.992	0.991
South Korea	0.6	0.832	0.992	1.035	0.993	0.857	0.971	0.999	0.986	0.992
Spain	0.5	0.756	0.966	1.028	0.997	0.831	0.955	0.987	0.999	0.992
Sweden	0.3	0.724	0.975	0.958	0.991	0.819	0.975	0.998	0.997	0.995
United Kingdom	0.7	0.809	1.026	0.994	0.992	0.862	0.959	0.985	0.997	0.995
United States	2.2	0.808	0.959	1.031	1.002	0.870	0.965	1.001	1.001	0.997
Rest of World	4.5	0.788	0.964	1.004	0.995	0.866	0.959	0.997	0.998	0.996

Table A.9: Trade during the Global Recession (Robustness, $\theta = 0.5$)

Notes: Each column reports the outcome of counterfactuals that include individual shock paths with all other shocks suppressed. The reported effects capture the annualized rate of growth of trade during the three quarter recession for each transition path. All values are relative to global GDP.

	Production / World GDP in 2008:Q3 (percent)	Change $\left(\frac{2009:Q2}{2008:Q3}\right)$ in Production in Various Counterfactuals								
		All Shocks (i.e. Data)	**Trade Friction Shocks** $\left(\hat{d}^j_{ni}\right)$	**Prod. Shocks** $\left(\hat{A}^j_n\right)$	**Inv. Efficy. in Structures Shocks** $\left(\hat{\chi}^C_n\right)$	**Inv. Efficy. in Durables Shocks** $\left(\hat{\chi}^D_n\right)$	**Nondurables Demand Shocks** $\left(\hat{\psi}^N_n\right)$	**Aggregate Demand Shocks** $\left(\hat{\phi}_n\right)$	**Services Deficits Shocks** $\left(D^S_n\right)$	**Labor Supply Shocks** $\left(\hat{L}_n\right)$
World	**61.9**	**0.870**	**0.984**	**1.021**	**1.001**	**0.905**	**0.958**	**0.998**	**0.998**	**0.997**
Austria	0.4	0.824	0.876	1.162	0.989	0.856	0.960	0.989	0.993	0.993
Canada	1.0	0.786	0.904	1.021	1.016	0.888	0.985	1.017	1.009	1.005
China	11.6	1.107	0.979	1.108	1.015	1.014	0.990	1.004	0.997	0.999
Czech Republic	0.4	0.723	1.038	0.883	0.990	0.821	0.967	0.993	0.992	0.991
Denmark	0.2	0.833	1.015	1.005	0.991	0.871	0.945	0.994	1.000	0.992
Finland	0.3	0.731	0.889	1.037	0.993	0.852	0.961	0.994	0.996	0.994
France	2.0	0.819	1.021	0.979	0.993	0.883	0.944	0.989	0.995	0.995
Germany	4.1	0.786	0.988	0.978	0.990	0.853	0.964	0.991	0.991	0.996
Greece	0.2	0.823	1.025	0.965	0.991	0.906	0.931	0.971	0.995	0.993
India	1.2	1.055	0.989	1.145	1.007	0.943	0.997	1.007	0.995	1.003
Italy	2.6	0.763	0.988	0.989	0.993	0.849	0.938	0.988	0.996	0.994
Japan	5.3	0.875	0.969	1.014	1.003	0.929	0.947	0.989	0.989	0.991
Mexico	1.1	0.763	1.014	0.929	0.999	0.871	0.983	0.977	1.002	1.003
Poland	0.6	0.736	0.991	0.964	0.974	0.837	0.972	0.984	0.995	0.997
Romania	0.2	0.694	1.051	0.900	0.995	0.816	0.938	0.976	0.997	0.993
South Korea	2.2	0.824	0.997	1.032	0.993	0.844	0.962	1.001	0.982	0.992
Spain	1.3	0.774	0.979	1.046	0.994	0.843	0.942	0.983	0.996	0.984
Sweden	0.5	0.711	0.949	0.938	0.990	0.825	0.972	1.004	0.994	0.992
United Kingdom	1.5	0.753	0.985	0.949	0.996	0.885	0.945	0.989	0.995	0.995
United States	8.9	0.861	0.990	1.042	0.999	0.903	0.932	0.999	0.997	0.991
Rest of World	16.3	0.794	0.985	0.990	1.003	0.877	0.955	1.005	1.007	1.003

Table A.10: Production during the Global Recession (Robustness, $\theta = 0.5$)

Notes: Each column reports the outcome of counterfactuals that include individual shock paths with all other shocks suppressed. The reported effects capture the growth of production during the three quarter recession for each transition path. All values are relative to global GDP.

		Change $\left(\frac{2009:Q2}{2008:Q3}\right)$ in GDP in Various Counterfactuals								
	GDP / World GDP in 2008:Q3 (percent)	**All Shocks (i.e. Data)**	**Trade Friction Shocks** $\left(\hat{d}^j_{ni}\right)$	**Prod. Shocks** $\left(\hat{A}^j_n\right)$	**Inv. Efficy. in Structures Shocks** $\left(\hat{\chi}^C_n\right)$	**Inv. Efficy. in Durables Shocks** $\left(\hat{\chi}^D_n\right)$	**Nondurables Demand Shocks** $\left(\hat{\psi}^N_n\right)$	**Aggregate Demand Shocks** $\left(\hat{\phi}_n\right)$	**Services Deficits Shocks** $\left(D^S_n\right)$	**Labor Supply Shocks** $\left(\hat{L}_n\right)$
World	**100**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**
Austria	0.7	0.979	0.981	1.054	1.007	0.999	1.008	0.996	1.009	1.011
Canada	2.6	0.914	0.958	0.959	0.993	0.982	0.970	0.930	0.973	0.974
China	7.5	1.154	1.000	1.067	1.041	1.038	1.002	1.055	1.008	1.011
Czech Republic	0.4	0.874	1.045	0.984	0.967	0.986	1.018	0.969	1.015	1.020
Denmark	0.6	0.931	1.010	0.997	0.988	1.007	1.001	0.950	0.982	1.000
Finland	0.5	0.920	0.964	1.003	0.988	0.974	0.998	0.988	1.002	0.999
France	4.7	0.979	1.012	0.994	0.991	1.009	1.002	0.971	1.006	1.002
Germany	6.0	0.958	1.007	0.995	1.004	0.979	1.002	0.984	1.013	1.006
Greece	0.6	1.002	1.027	1.004	1.013	1.030	1.020	0.977	1.011	1.015
India	2.1	1.031	0.983	1.027	0.997	1.002	0.982	0.966	1.007	0.988
Italy	3.8	0.974	1.009	0.996	1.002	0.982	1.010	1.008	1.007	1.008
Japan	7.4	1.172	1.012	1.016	1.045	1.023	1.018	1.118	1.028	1.016
Mexico	1.9	0.817	1.002	0.964	0.957	0.985	0.988	0.868	0.994	0.991
Poland	0.9	0.775	1.023	1.026	0.920	0.989	1.007	0.867	1.008	1.013
Romania	0.3	0.830	1.055	0.987	1.045	1.011	1.037	0.878	1.011	1.030
South Korea	1.6	0.939	1.026	1.040	1.010	0.973	1.023	0.978	1.049	1.023
Spain	2.6	0.968	1.009	1.018	1.012	1.008	1.013	0.969	1.011	1.006
Sweden	0.8	0.850	0.997	0.977	0.992	0.980	0.997	0.927	1.003	1.003
United Kingdom	4.5	0.869	1.002	0.974	0.981	1.006	0.999	0.884	1.002	0.997
United States	23.9	1.075	1.016	1.020	1.016	1.025	1.015	1.045	1.018	1.012
Rest of World	26.5	0.925	0.978	0.967	0.972	0.969	0.979	0.972	0.966	0.979

Table A.11: GDP during the Global Recession (Robustness, $\theta = 0.5$)

Notes: Each column reports the outcome of counterfactuals that include individual shock paths with all other shocks suppressed. The reported effects capture the growth of GDP during the three quarter recession for each transition path. All values are relative to global GDP.

		Change $\left(\frac{2011:Q1}{2009:Q2}\right)$ in Trade in Various Counterfactuals								
	Trade / World GDP in 2009:Q2 (percent)	**All Shocks (i.e. Data)**	**Trade Friction Shocks** $\left(\hat{d}^j_{ni}\right)$	**Prod. Shocks** $\left(\hat{A}^j_n\right)$	**Inv. Efficy. in Structures Shocks** $\left(\hat{\chi}^C_n\right)$	**Inv. Efficy. in Durables Shocks** $\left(\hat{\chi}^D_n\right)$	**Nondurables Demand Shocks** $\left(\hat{\psi}^N_n\right)$	**Aggregate Demand Shocks** $\left(\hat{\phi}_n\right)$	**Services Deficits Shocks** $\left(D^S_n\right)$	**Labor Supply Shocks** $\left(\hat{L}_n\right)$
World	**13.9**	**1.218**	**1.190**	**0.947**	**0.998**	**1.070**	**1.023**	**0.995**	**0.998**	**0.997**
Austria	0.2	1.111	1.224	0.830	0.993	1.021	1.035	0.992	0.992	0.993
Canada	0.4	1.208	1.246	0.938	1.015	1.054	1.016	1.006	1.009	1.010
China	1.5	1.382	1.236	1.007	1.010	1.139	1.026	1.000	1.009	1.004
Czech Republic	0.2	1.258	1.494	0.765	0.994	1.059	1.011	0.992	0.991	0.990
Denmark	0.1	1.012	2.556	0.585	0.993	0.982	1.015	0.995	0.997	0.992
Finland	0.1	1.079	1.083	0.956	0.987	1.058	1.001	0.991	0.991	0.989
France	0.8	1.053	1.077	0.942	0.994	1.021	1.027	0.993	0.999	0.998
Germany	1.5	1.141	1.114	0.938	0.990	1.042	1.020	0.990	0.992	0.991
Greece	0.1	0.724	0.849	1.028	0.924	0.897	1.034	0.924	1.001	0.994
India	0.2	1.468	1.254	1.048	1.022	1.142	1.016	1.016	1.003	1.007
Italy	0.6	1.107	1.097	0.939	0.992	1.035	1.026	0.986	0.995	0.993
Japan	0.7	1.269	1.118	0.978	1.002	1.107	1.033	0.999	0.997	0.994
Mexico	0.3	1.289	1.545	0.822	1.010	1.032	1.036	1.014	1.013	1.012
Poland	0.2	1.184	1.124	0.960	1.008	1.030	1.030	0.994	0.994	0.991
Romania	0.1	1.291	1.425	0.837	0.964	1.019	1.001	0.975	0.980	0.976
South Korea	0.5	1.279	1.038	1.006	1.007	1.174	1.014	1.001	1.004	1.001
Spain	0.4	1.127	1.244	0.899	0.964	1.020	1.033	0.987	1.000	0.994
Sweden	0.2	1.253	1.205	0.979	0.997	1.081	1.011	0.993	0.993	0.992
United Kingdom	0.6	1.183	1.398	0.846	0.988	0.995	0.995	0.989	0.992	0.991
United States	1.7	1.176	1.203	0.940	1.003	1.051	1.032	0.998	1.008	1.004
Rest of World	3.5	1.252	1.126	0.981	0.998	1.088	1.024	0.995	0.991	0.994

Table A.12: Trade during the Recovery (Robustness, $\theta = 0.5$)

Notes: Each column reports the outcome of counterfactuals that include individual shock paths with all other shocks suppressed. The reported effects capture the annualized rate of growth of trade during the three quarter recession for each transition path. All values are relative to global GDP.

	Production / World GDP in 2009:Q2 (percent)	All Shocks (i.e. Data)	Trade Friction Shocks $\left(\hat{d}^{j}_{ni}\right)$	Prod. Shocks $\left(\hat{A}^{j}_{n}\right)$	Inv. Efficy. in Structures Shocks $\left(\hat{\chi}^{C}_{n}\right)$	Inv. Efficy. in Durables Shocks $\left(\hat{\chi}^{D}_{n}\right)$	Nondurables Demand Shocks $\left(\hat{\psi}^{N}_{n}\right)$	Aggregate Demand Shocks $\left(\hat{\phi}_{n}\right)$	Services Deficits Shocks $\left(D^{S}_{n}\right)$	Labor Supply Shocks $\left(\hat{L}_{n}\right)$
		Change $\left(\frac{2011:Q1}{2009:Q2}\right)$ in Production in Various Counterfactuals								
World	**53.9**	**1.167**	**1.064**	**0.973**	**1.003**	**1.084**	**1.032**	**1.000**	**0.996**	**0.997**
Austria	0.3	1.053	1.172	0.803	0.998	1.045	1.040	1.000	0.995	0.998
Canada	0.8	1.126	1.167	0.945	1.008	1.043	1.006	0.995	1.004	1.009
China	12.8	1.260	1.081	1.018	1.020	1.181	1.023	1.015	1.001	1.000
Czech Republic	0.3	1.117	1.440	0.701	0.994	1.055	1.017	0.998	0.994	0.993
Denmark	0.2	0.886	2.688	0.413	0.994	1.022	1.017	0.996	0.989	0.982
Finland	0.2	0.998	0.990	0.953	0.993	1.050	1.001	0.997	0.995	0.991
France	1.6	0.980	0.989	0.930	0.993	1.018	1.029	0.991	0.997	0.994
Germany	3.2	1.098	1.041	0.943	0.989	1.037	1.018	0.994	0.992	0.989
Greece	0.1	0.890	0.898	1.134	0.958	0.923	1.048	0.937	1.000	0.988
India	1.3	1.327	1.110	1.075	1.016	1.116	0.988	1.036	0.999	1.001
Italy	2.0	0.999	0.990	0.926	0.993	1.024	1.029	0.983	0.997	0.992
Japan	4.7	1.164	1.029	0.978	1.010	1.070	1.064	1.002	1.001	0.994
Mexico	0.8	1.164	1.346	0.818	1.000	1.012	1.049	1.016	1.002	1.004
Poland	0.5	1.168	1.075	0.991	1.002	1.021	1.050	0.993	0.995	0.990
Romania	0.1	1.110	1.320	0.760	0.999	1.026	1.035	0.992	0.996	0.997
South Korea	1.8	1.297	1.020	1.017	1.011	1.189	1.018	1.005	1.010	1.006
Spain	1.0	0.960	1.074	0.850	0.974	1.014	1.042	0.986	1.000	0.990
Sweden	0.3	1.286	1.167	1.033	0.990	1.073	1.009	0.979	0.994	0.990
United Kingdom	1.2	0.973	1.213	0.750	0.994	1.004	0.989	0.990	0.992	0.991
United States	7.6	1.020	1.031	0.927	1.000	1.026	1.048	0.993	1.002	0.996
Rest of World	13.0	1.242	1.039	1.040	1.000	1.087	1.035	0.997	0.986	0.997

Table A.13: Production during the Recovery (Robustness, $\theta = 0.5$)

Notes: Each column reports the outcome of counterfactuals that include individual shock paths with all other shocks suppressed. The reported effects capture the growth of production during the seven quarter recovery for each transition path. All values are relative to global GDP.

	GDP / World GDP in 2009:Q2 (percent)	Change $\left(\frac{2011:Q1}{2009:Q2}\right)$ in GDP in Various Counterfactuals								
		All Shocks (i.e. Data)	**Trade Friction Shocks** $\left(\hat{d}^j_{ni}\right)$	**Prod. Shocks** $\left(\hat{A}^j_n\right)$	**Inv. Efficy. in Structures Shocks** $\left(\hat{\chi}^C_n\right)$	**Inv. Efficy. in Durables Shocks** $\left(\hat{\chi}^D_n\right)$	**Nondurables Demand Shocks** $\left(\hat{\psi}^N_n\right)$	**Aggregate Demand Shocks** $\left(\hat{\phi}_n\right)$	**Services Deficits Shocks** $\left(D^S_n\right)$	**Labor Supply Shocks** $\left(\hat{L}_n\right)$
World	**100.0**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**
Austria	0.7	0.912	1.008	0.923	0.983	0.971	0.976	0.951	0.991	0.986
Canada	2.4	1.107	1.009	1.004	1.014	0.983	1.008	1.086	1.002	1.003
China	8.7	1.164	1.021	1.010	1.013	1.079	0.991	1.064	0.947	0.987
Czech Republic	0.3	0.933	1.131	0.861	0.994	0.973	0.982	0.942	0.985	0.980
Denmark	0.5	0.923	1.275	0.880	0.988	0.977	1.006	0.973	1.003	0.994
Finland	0.4	0.917	0.990	1.008	0.985	0.998	1.010	0.960	0.997	1.002
France	4.6	0.889	0.975	0.988	0.984	0.974	0.997	0.951	0.989	0.996
Germany	5.7	0.925	1.009	0.997	1.006	1.001	1.007	0.955	0.995	1.008
Greece	0.6	0.748	0.947	1.027	0.923	0.954	0.990	0.838	0.997	0.993
India	2.2	1.260	1.005	1.038	1.022	1.009	1.001	1.180	0.975	0.996
Italy	3.7	0.869	0.982	0.975	0.989	0.983	0.999	0.926	0.995	0.997
Japan	8.7	0.986	0.982	0.986	1.019	0.998	0.989	1.001	0.980	0.992
Mexico	1.6	1.085	1.074	0.965	1.006	0.982	1.000	1.086	1.002	1.004
Poland	0.7	1.061	0.999	0.985	1.035	0.971	0.986	1.018	0.999	0.990
Romania	0.3	0.934	1.048	0.916	0.945	0.941	0.972	0.925	1.012	0.973
South Korea	1.5	1.108	0.974	0.994	0.990	1.040	0.983	1.032	0.956	0.983
Spain	2.6	0.844	0.995	0.953	0.933	0.963	0.987	0.935	0.988	0.985
Sweden	0.7	1.137	1.031	1.022	1.023	1.002	1.004	1.082	0.989	1.002
United Kingdom	3.9	0.937	1.022	0.972	0.982	0.977	1.009	0.982	1.002	1.003
United States	25.7	0.890	0.986	0.993	0.989	0.985	1.001	0.947	0.999	1.001
Rest of World	24.5	1.108	1.001	1.033	1.014	1.011	1.005	1.045	1.031	1.008

Table A.14: GDP during the Recovery (Robustness, $\theta = 0.5$)

Notes: Each column reports the outcome of counterfactuals that include individual shock paths with all other shocks suppressed. The reported effects capture the growth of GDP during the seven quarter recovery for each transition path. All values are relative to global GDP.

	2008:Q3 Values (percent)						Change $\left(\frac{2009:Q2}{2008:Q3}\right)$ in					
	Exports/GDP			Imports/GDP			Exports/GDP			Imports/GDP		
	All	Dur	Nondur	All	Dur	Nondur	All	Dur	Nondur	All	Dur	Nondur
World	**17.5**	**12.1**	**5.4**	**17.5**	**12.1**	**5.4**	**0.795**	**0.762**	**0.871**	**0.795**	**0.762**	**0.871**
Austria	41.7	29.7	12.0	37.3	25.4	11.9	0.779	0.731	0.898	0.839	0.798	0.926
Canada	18.1	12.4	5.7	21.6	15.5	6.2	0.776	0.738	0.858	0.864	0.814	0.987
China	31.2	22.9	8.3	16.7	12.3	4.4	0.700	0.675	0.769	0.808	0.816	0.786
Czech Republic	60.7	48.9	11.7	52.6	37.9	14.7	0.856	0.840	0.922	0.851	0.817	0.938
Denmark	28.1	15.2	12.9	28.0	17.7	10.2	0.909	0.832	0.999	0.822	0.756	0.935
Finland	32.2	22.8	9.4	26.1	18.7	7.4	0.734	0.680	0.866	0.734	0.681	0.867
France	19.3	11.7	7.5	20.2	12.8	7.4	0.843	0.812	0.890	0.849	0.820	0.898
Germany	38.0	27.2	10.9	26.8	17.9	8.9	0.815	0.782	0.898	0.824	0.785	0.904
Greece	6.2	2.8	3.4	20.6	11.8	8.7	0.827	0.785	0.861	0.834	0.815	0.859
India	10.9	6.2	4.7	15.8	11.4	4.4	0.849	0.838	0.863	0.777	0.760	0.823
Italy	21.6	14.3	7.3	18.6	11.6	7.1	0.803	0.768	0.872	0.776	0.708	0.888
Japan	15.9	13.5	2.3	9.2	5.9	3.3	0.630	0.609	0.749	0.711	0.648	0.821
Mexico	19.9	16.7	3.2	22.9	16.6	6.3	0.982	0.965	1.073	0.918	0.896	0.975
Poland	28.7	20.7	8.0	30.6	20.2	10.3	1.016	0.979	1.111	0.943	0.910	1.008
Romania	20.5	14.2	6.2	34.3	22.4	12.0	1.008	1.010	1.004	0.781	0.711	0.911
South Korea	42.0	34.4	7.6	29.9	22.2	7.7	0.942	0.948	0.917	0.808	0.782	0.880
Spain	15.5	9.6	6.0	19.9	12.5	7.4	0.833	0.791	0.900	0.742	0.643	0.911
Sweden	33.0	23.5	9.5	28.0	19.3	8.7	0.860	0.790	1.033	0.841	0.781	0.974
United Kingdom	14.3	9.3	5.0	18.9	12.1	6.8	0.909	0.850	1.021	0.948	0.890	1.051
United States	7.7	5.5	2.2	10.3	7.3	3.0	0.760	0.739	0.810	0.745	0.709	0.833
Rest of World	14.5	8.8	5.7	19.5	14.0	5.5	0.864	0.810	0.948	0.842	0.814	0.914

Table A.15: Sectoral and Total Imports/GDP and Exports/GDP during the Global Recession

Notes: Change for each variables equals the ratio of the value for 2009:Q2 to that for 2008:Q3, so that 1 implies no change. All values are relative to global GDP.

	2009:Q2 Values (percent)						Change $\left(\frac{2011:Q1}{2009:Q2}\right)$ in					
	Exports/GDP			Imports/GDP			Exports/GDP			Imports/GDP		
	All	Dur	Nondur	All	Dur	Nondur	All	Dur	Nondur	All	Dur	Nondur
World	**13.9**	**9.2**	**4.7**	**13.9**	**9.2**	**4.7**	**1.218**	**1.251**	**1.152**	**1.218**	**1.251**	**1.152**
Austria	32.5	21.7	10.8	31.3	20.3	11.0	1.219	1.260	1.135	1.216	1.251	1.153
Canada	14.1	9.1	4.9	18.7	12.6	6.1	1.113	1.158	1.030	1.074	1.135	0.948
China	21.9	15.5	6.4	13.5	10.0	3.5	1.177	1.192	1.141	1.202	1.185	1.249
Czech Republic	51.9	41.1	10.8	44.8	31.0	13.8	1.339	1.352	1.291	1.359	1.399	1.268
Denmark	25.6	12.6	12.9	23.0	13.4	9.5	1.131	1.153	1.108	1.058	1.047	1.074
Finland	23.7	15.5	8.1	19.2	12.7	6.5	1.147	1.095	1.246	1.214	1.227	1.189
France	16.2	9.5	6.7	17.2	10.5	6.7	1.165	1.186	1.135	1.201	1.212	1.183
Germany	31.0	21.2	9.8	22.1	14.1	8.0	1.225	1.264	1.140	1.246	1.278	1.188
Greece	5.1	2.2	2.9	17.2	9.6	7.5	1.235	1.369	1.133	0.887	0.747	1.068
India	9.2	5.2	4.1	12.3	8.7	3.6	1.287	1.420	1.117	1.073	1.152	0.882
Italy	17.4	11.0	6.4	14.5	8.2	6.3	1.217	1.217	1.217	1.342	1.397	1.269
Japan	10.0	8.2	1.7	6.5	3.8	2.7	1.321	1.332	1.270	1.236	1.273	1.185
Mexico	19.6	16.1	3.4	21.0	14.9	6.1	1.204	1.225	1.105	1.172	1.191	1.128
Poland	29.2	20.3	8.9	28.8	18.4	10.4	1.098	1.083	1.134	1.134	1.119	1.161
Romania	20.6	14.4	6.2	26.8	15.9	10.9	1.465	1.519	1.342	1.320	1.378	1.236
South Korea	39.6	32.6	7.0	24.1	17.3	6.8	1.149	1.133	1.227	1.163	1.140	1.223
Spain	12.9	7.6	5.4	14.8	8.1	6.7	1.361	1.424	1.274	1.314	1.370	1.247
Sweden	28.3	18.5	9.8	23.5	15.1	8.5	1.090	1.168	0.941	1.117	1.195	0.979
United Kingdom	13.0	7.9	5.1	17.9	10.8	7.1	1.349	1.491	1.128	1.200	1.288	1.067
United States	5.8	4.0	1.8	7.7	5.2	2.5	1.292	1.299	1.275	1.343	1.395	1.234
Rest of World	12.5	7.2	5.4	16.4	11.4	5.0	1.112	1.157	1.053	1.144	1.164	1.099

Table A.16: Sectoral and Total Imports/GDP and Exports/GDP during the Recovery

Notes: Change for each variables equals the ratio of the value for 2011:Q1 to that for 2009:Q2, so that 1 implies no change. All values are relative to global GDP.

	Changes $\left(\frac{2009:Q2}{2008:Q3}\right)$ During the Recession						Changes $\left(\frac{2011:Q1}{2009:Q2}\right)$ During the Recovery					
	Prices				**Domestic Shares of Absorption**		**Prices**				**Domestic Shares of Absorption**	
	$\hat{p}_n^C$	$\hat{p}_n^D$	$\hat{p}_n^N$	$\hat{p}_n^S$	$\hat{\pi}_{nn}^D$	$\hat{\pi}_{nn}^N$	$\hat{p}_n^C$	$\hat{p}_n^D$	$\hat{p}_n^N$	$\hat{p}_n^S$	$\hat{\pi}_{nn}^D$	$\hat{\pi}_{nn}^N$
Austria	0.998	0.964	0.942	0.988	1.240	0.973	0.944	0.918	0.900	0.877	0.738	1.129
Canada	1.086	0.945	0.929	0.889	1.043	1.001	0.963	1.029	1.049	1.102	0.911	0.996
China	1.156	0.926	0.949	1.102	1.030	1.020	0.956	1.019	1.021	1.036	0.989	0.986
Czech Republic	0.763	0.855	0.848	0.896	0.908	0.959	1.168	0.957	0.976	0.901	0.740	0.842
Denmark	0.927	0.965	0.957	0.944	1.169	0.887	0.850	0.899	0.910	0.928	0.182	0.743
Finland	1.018	0.943	0.919	0.974	1.066	1.020	0.749	0.910	0.917	0.900	0.980	0.904
France	0.953	0.952	0.898	0.974	0.981	0.987	0.882	0.894	0.891	0.880	0.944	0.941
Germany	0.950	0.953	0.936	0.991	0.999	1.005	0.880	0.894	0.906	0.876	0.965	0.948
Greece	0.978	0.936	0.959	0.997	0.942	1.010	0.860	0.932	0.878	0.877	1.241	1.041
India	1.023	0.915	0.964	0.932	1.105	1.038	1.036	1.028	1.068	1.126	0.970	1.016
Italy	1.016	0.934	0.935	0.998	1.005	0.987	0.926	0.904	0.901	0.856	0.952	0.945
Japan	1.215	1.124	1.123	1.215	1.015	1.009	1.106	1.012	1.037	0.965	0.978	1.006
Mexico	0.823	0.821	0.852	0.819	0.917	1.002	1.028	1.049	1.056	1.027	0.721	0.998
Poland	0.548	0.689	0.721	0.739	0.947	0.985	1.154	0.993	1.028	1.022	0.968	0.993
Romania	0.904	0.841	0.864	0.783	0.933	0.928	0.907	0.926	0.948	0.807	0.713	0.872
South Korea	0.898	0.854	0.857	0.938	1.016	1.001	1.037	1.106	1.043	1.027	1.023	0.963
Spain	0.988	0.935	0.940	0.956	1.059	0.971	0.877	0.902	0.907	0.864	0.860	0.960
Sweden	0.909	0.847	0.841	0.854	0.942	1.020	1.106	1.099	1.093	1.102	1.025	1.063
United Kingdom	0.947	0.879	0.884	0.851	1.023	0.874	0.812	0.925	0.935	0.950	0.726	0.884
United States	1.051	1.025	0.888	1.093	1.028	1.003	0.879	0.903	1.041	0.871	0.926	0.981
Rest of World	0.957	0.915	0.911	0.915	1.005	0.998	0.957	0.965	0.975	1.141	0.995	0.999

Table A.17: Prices and Domestic Shares of Absorption During the Global Recession and Recovery

Notes: Variables denoting changes equal the ratio of the value for 2009:Q2 to that for 2008:Q3, so that 1 implies no change. All values are relative to global GDP.

Comparison of Trade Wedges with LLT

	(1)	(2)	(3)	(4)	(5)
LLT Wedge:	**Overall, Non-Oil**	**Durable**		**Consumption**	
LLT Imports:	Non-Oil Goods	Dur Goods (BEA)		Cons. Goods	
LL Demand:	$(C + I)$	I		C	
LLT Estimate:	-0.401	-0.251		-0.019	
EKNR Tr. Fric:			**Durables**		**Nondurables**
EKNR Imports:	Mfg.	$j = D$	$j = D$		$j = N$
EKNR Demand:	$\sum_{\Omega} X^{F,j}$	$(X^{F,C} + X^{F,D})$	X^{D}		X^{N}
EKNR Estimate:	-0.561	-0.289	-0.274		-0.011

Table A.18: Import Wedges in LLT and EKNR

Notes: Levchenko, Lewis, and Tesar (2010) referred to as "LLT". Calculations for U.S. with $\epsilon = 3$ ($\theta = 2$) for 4-quarter period ending 2009:Q2. LLT numbers are a weighted average of their $\epsilon = 1.5$ and $\epsilon = 6$ results, with weights 2/3 and 1/3.

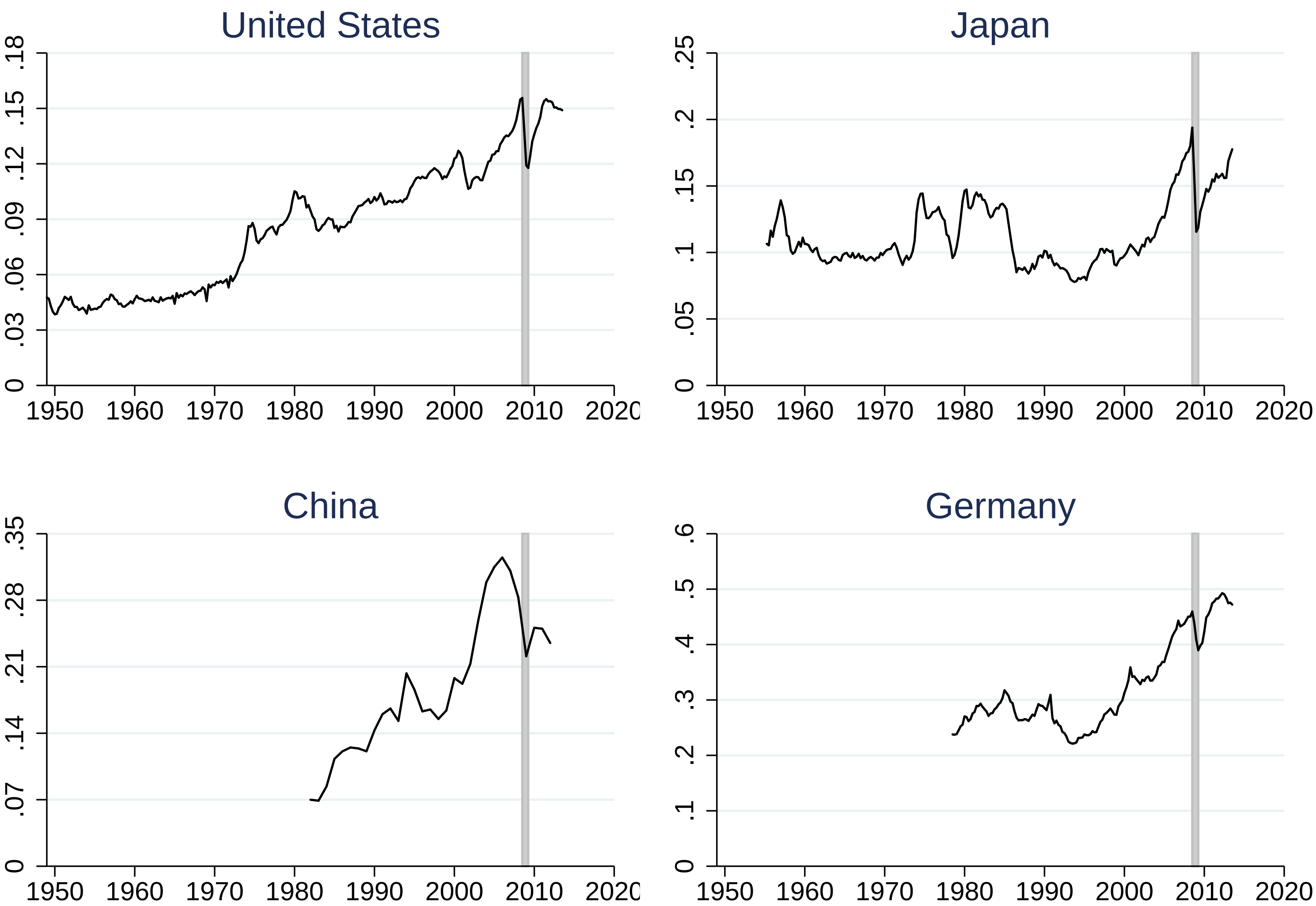

Figure A.1: Trade-GDP Ratio in the Four Largest Economies

Notes: The shaded bars highlight 2008:Q3 to 2009:Q2. Trade is measured as the average of exports and imports. Data are quarterly except for China, which are annual. See Appendix Section A for details.

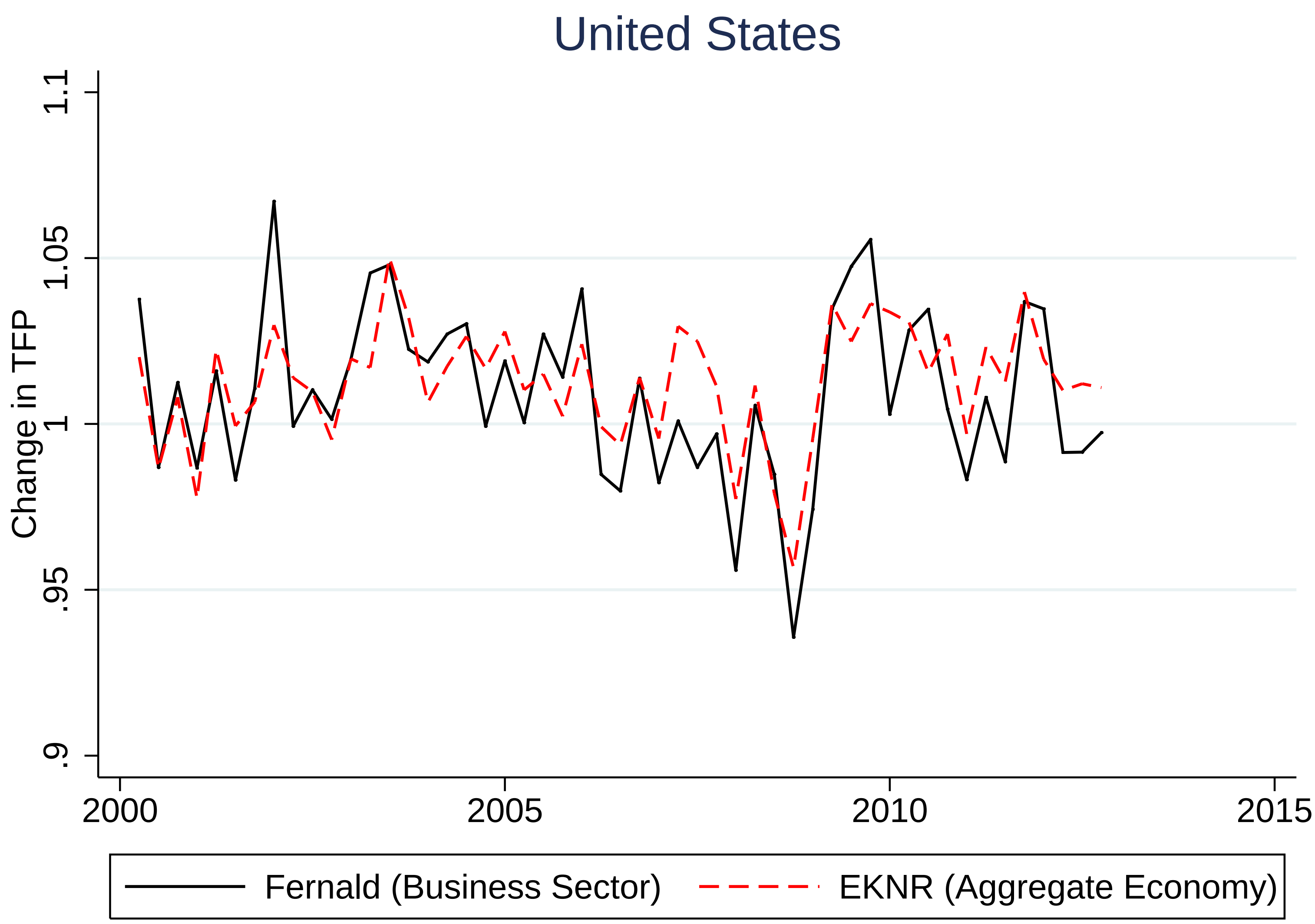

Figure A.2: Comparing Aggregate Productivity Growth for the United States

Notes: Plot compares quarterly growth in U.S. aggregate productivity series to estimates in Fernald et al. (2012) for the U.S. business sector.

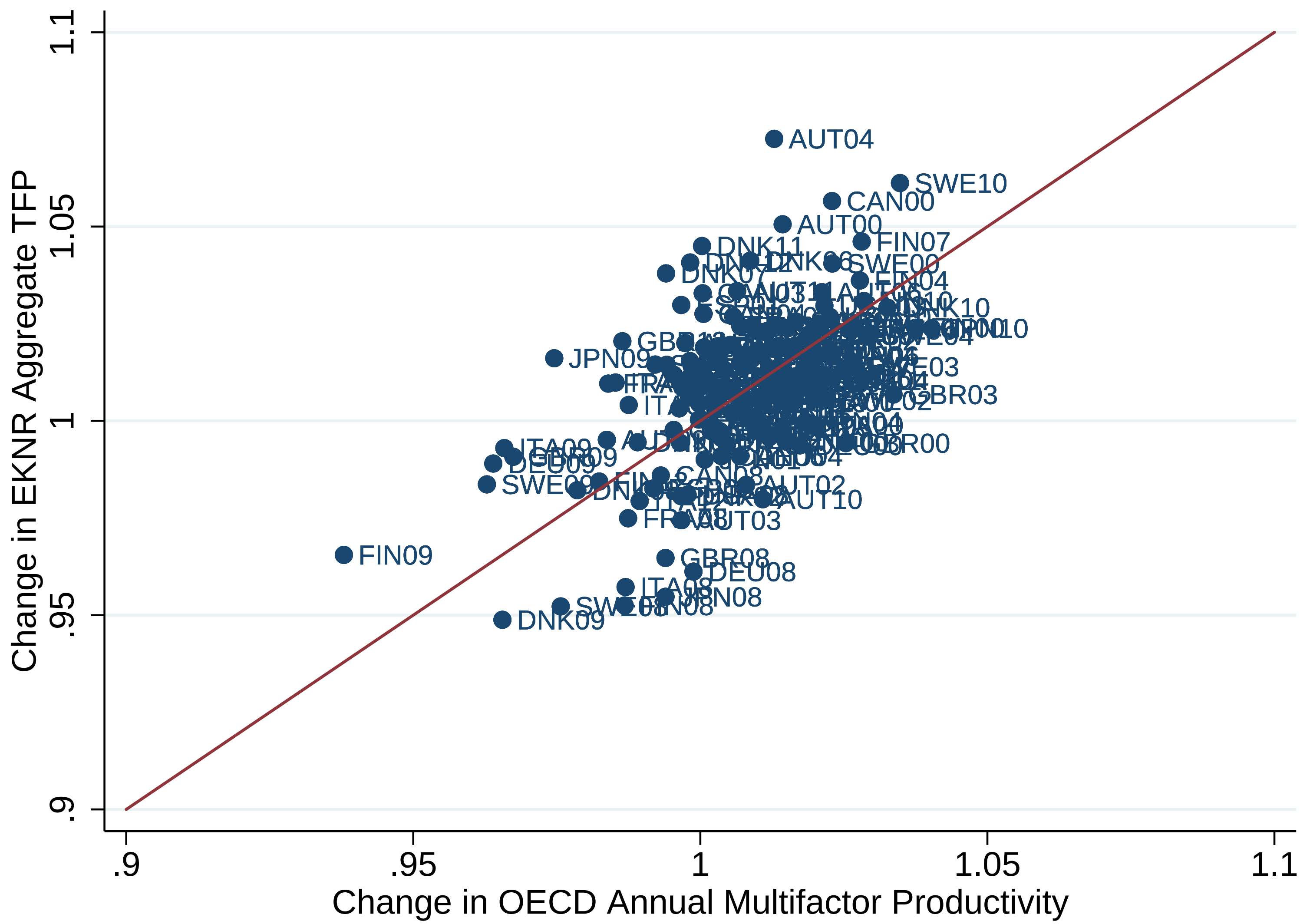

Figure A.3: Comparing Aggregate Productivity Growth for all Country-Years

Notes: Plot compares annual growth in aggregate productivity for all overlapping country-years in our data and in the OECD's multifactor productivity database.

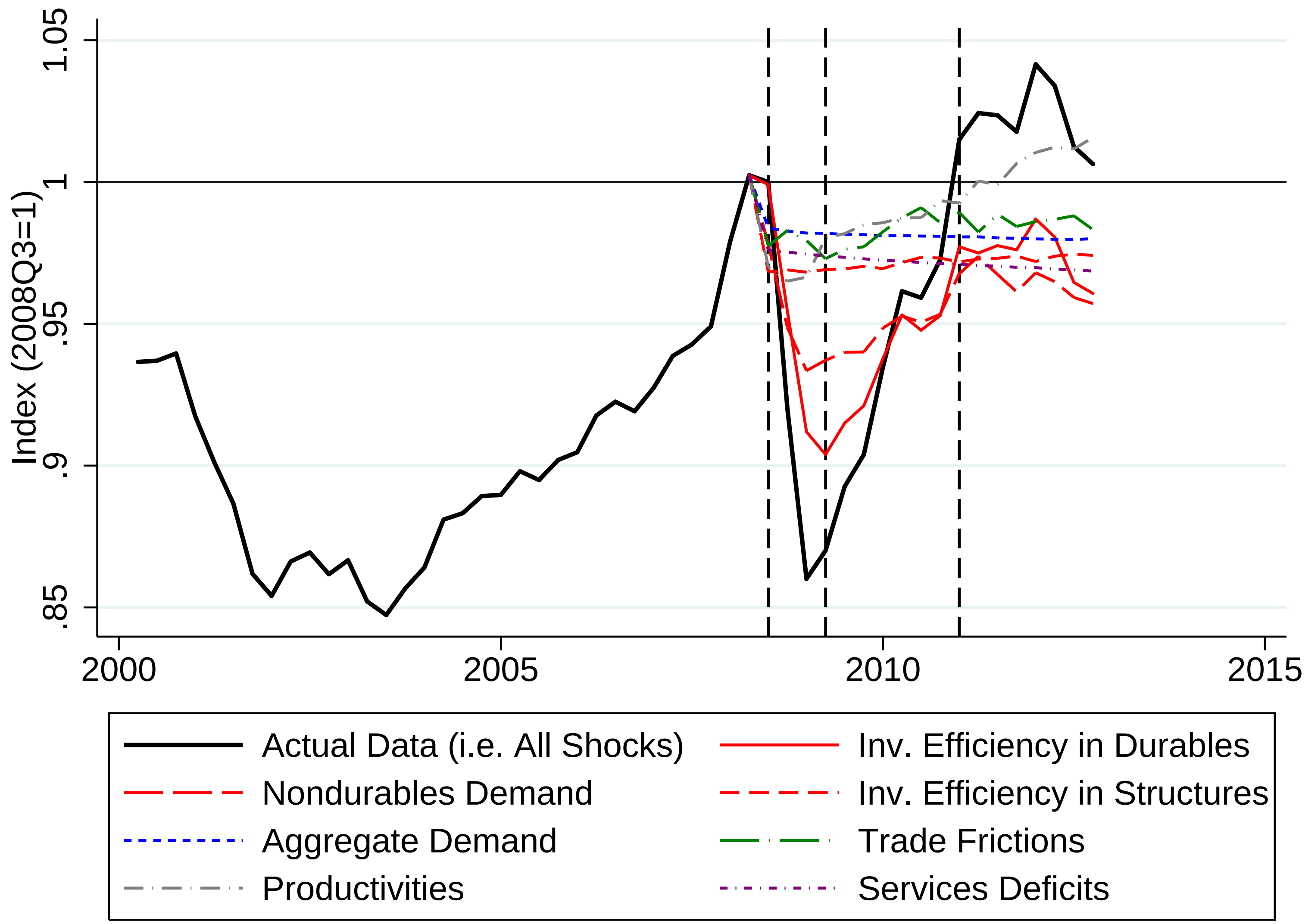

Figure A.4: Actual and Counterfactual Evolution of Global Production

Notes: Lines beginning in 2008:Q3 represent counterfactual outcomes with the indicated shocks at their calibrated values and all other shocks unchanged. All values are relative to global GDP.

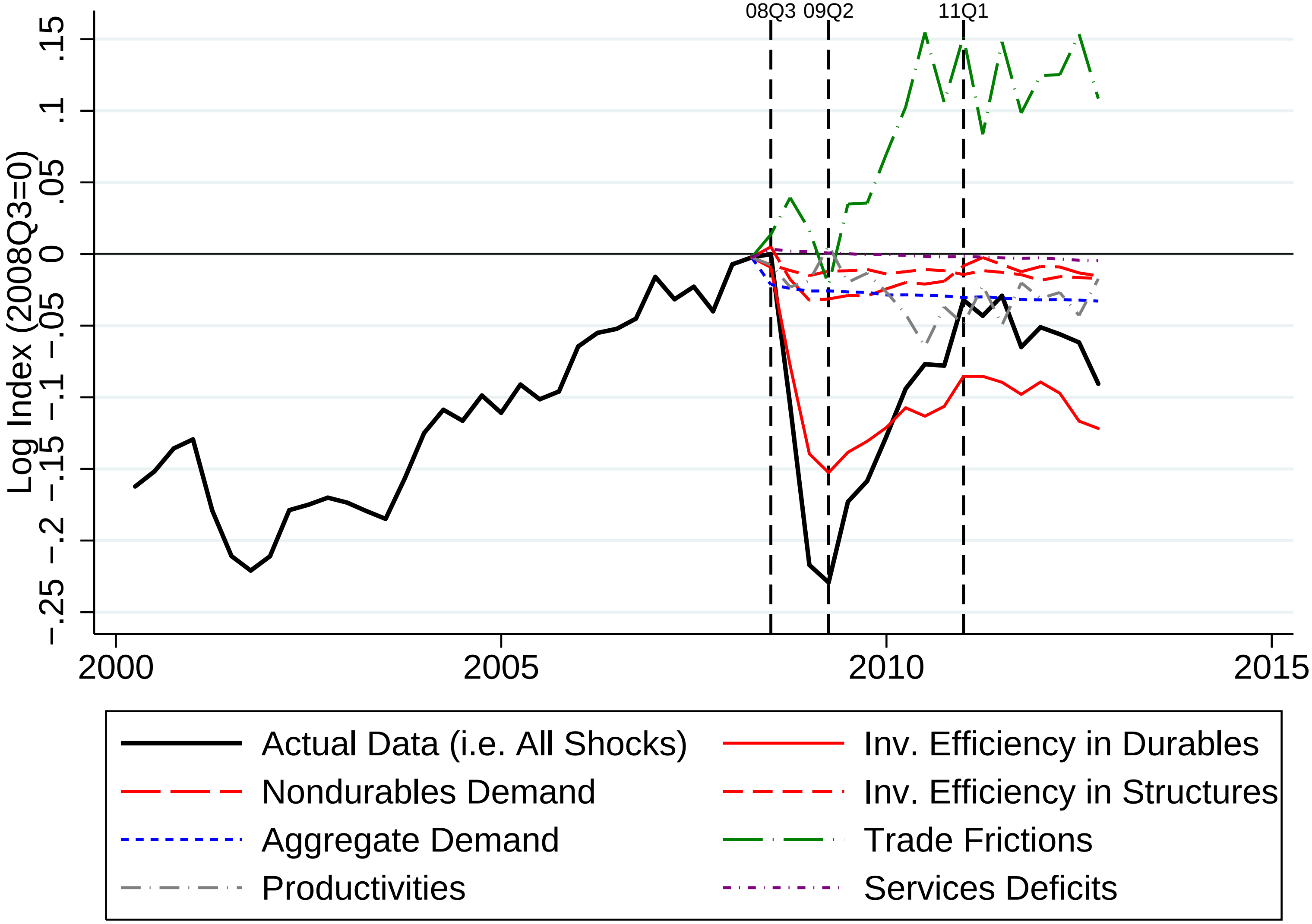

Figure A.5: Actual and Counterfactual Evolution of Global Trade (Robustness, $\theta = 0.5$)

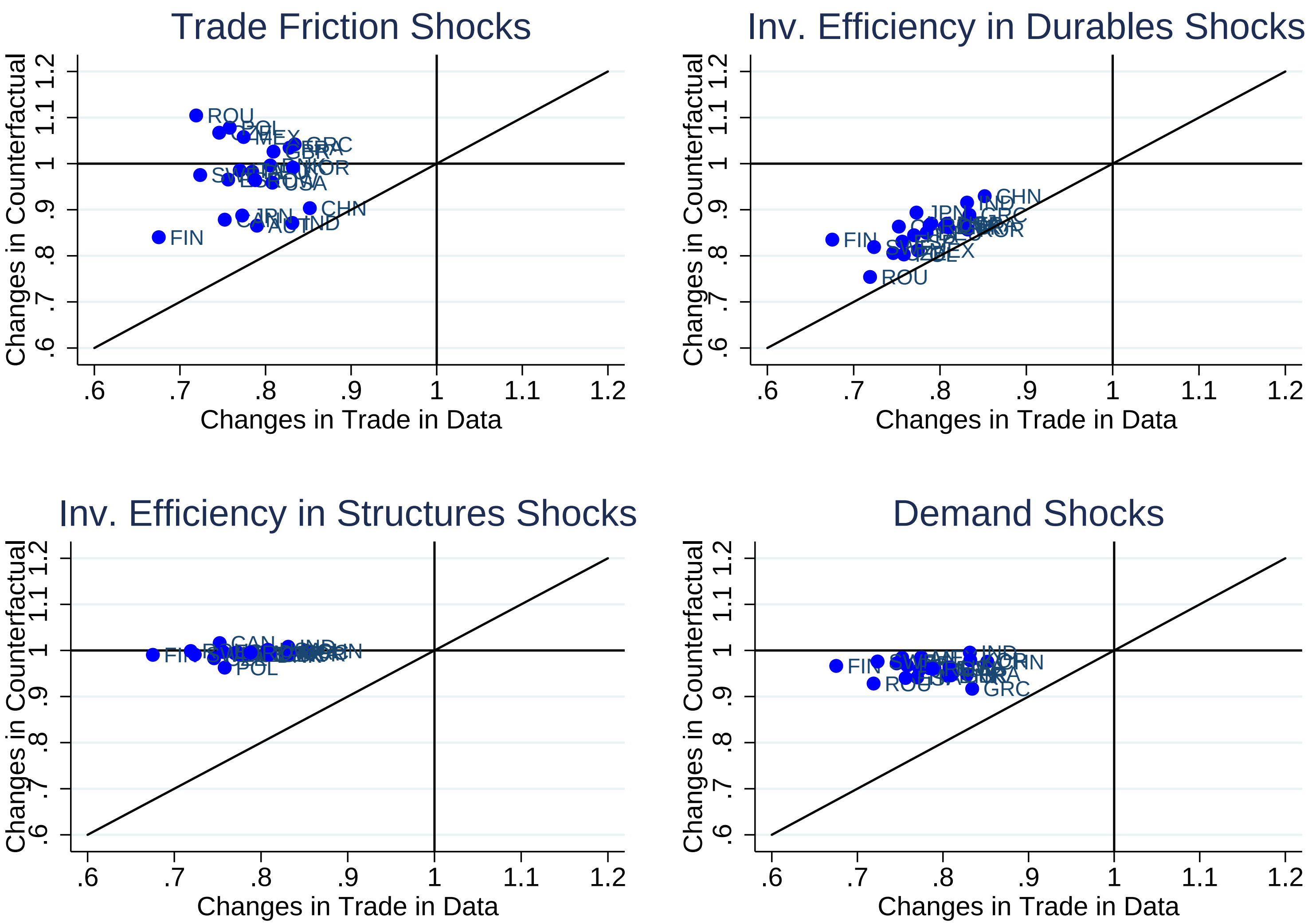

Figure A.6: Cross-Sectional Explanatory Power of Various Shocks for Trade during the Great Recession (Robustness, $\theta = 0.5$)

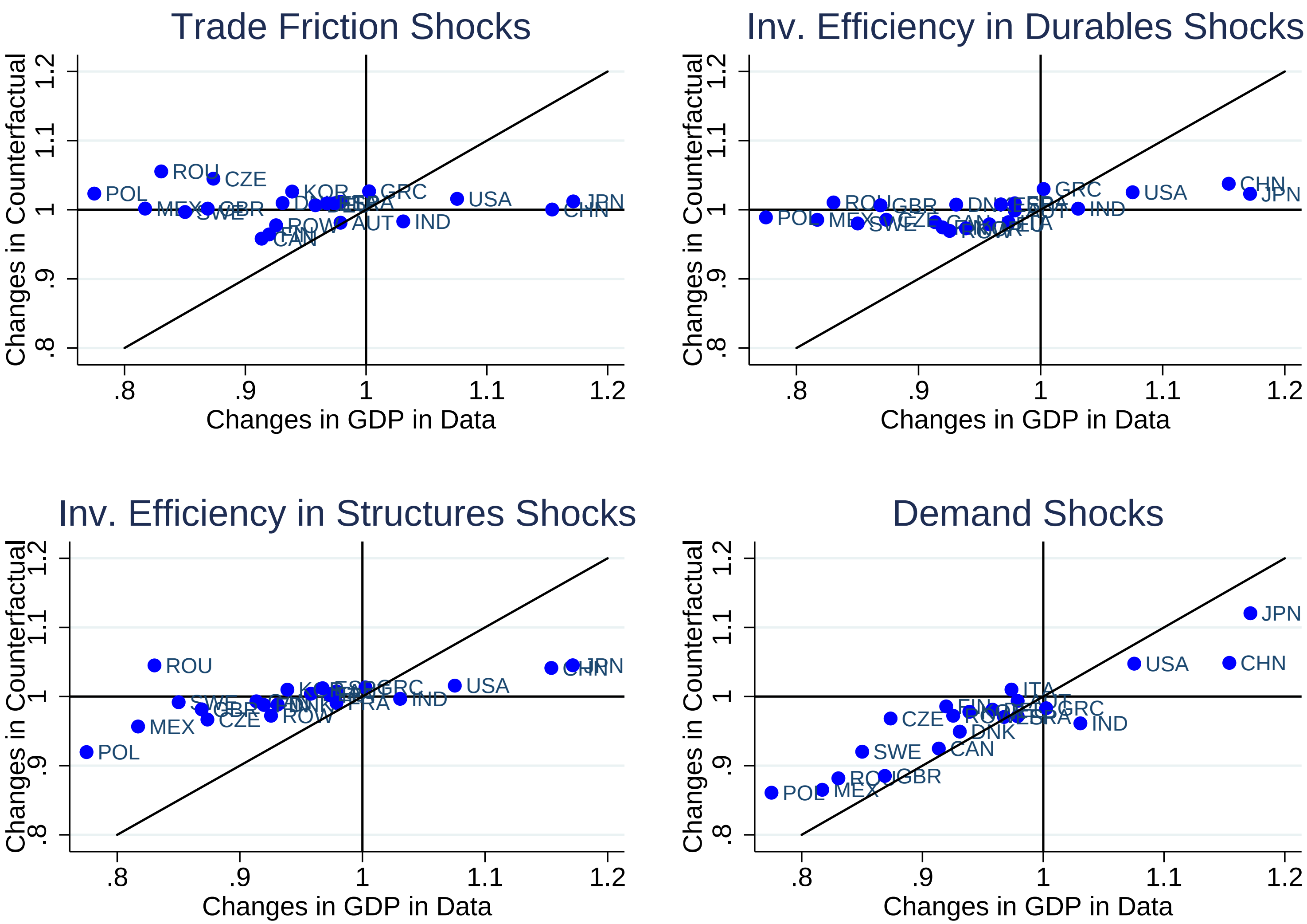

Figure A.7: Cross-Sectional Explanatory Power of Various Shocks for GDP during the Great Recession (Robustness, $\theta = 0.5$)

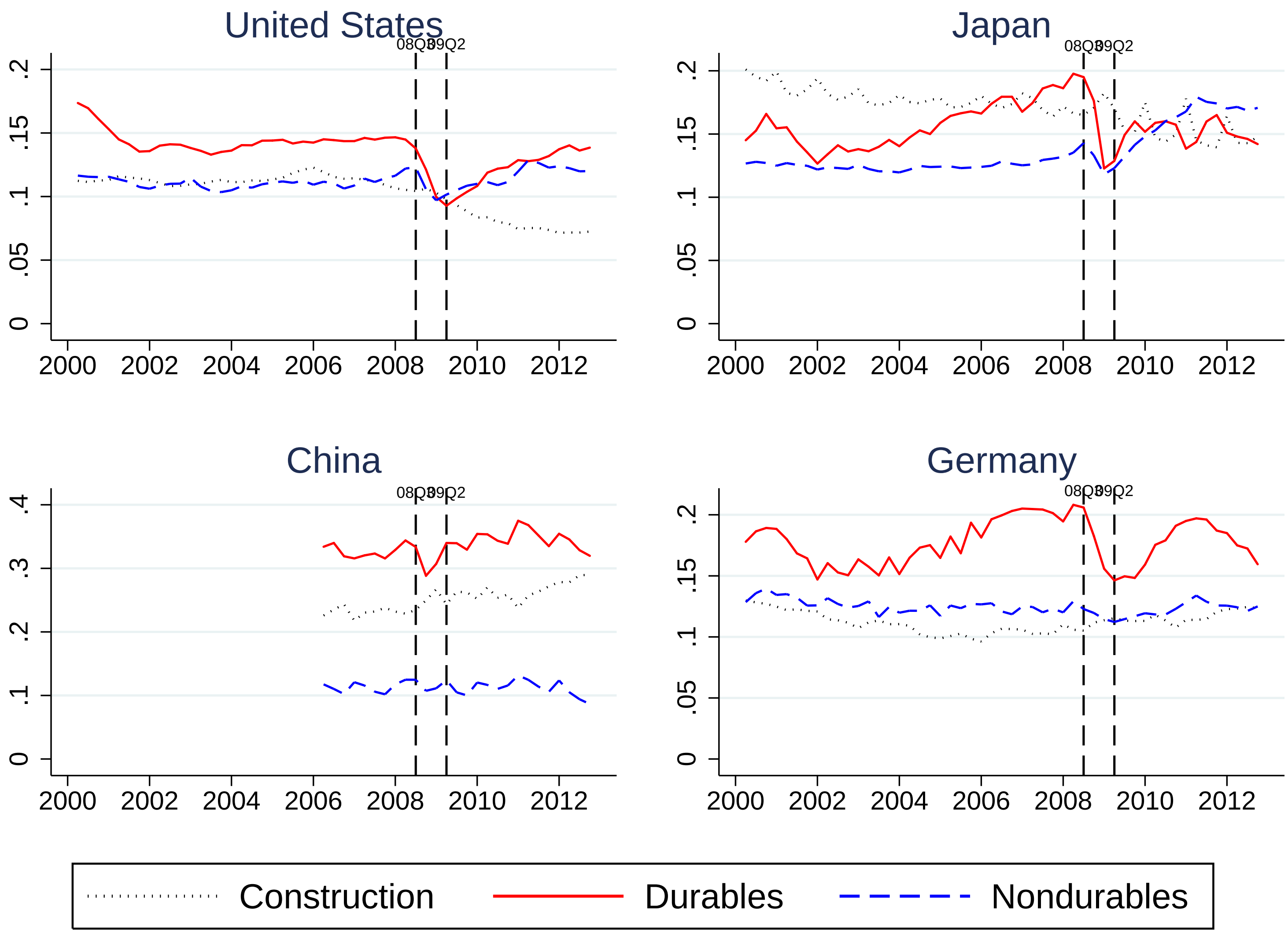

Figure A.8: Final Spending Shares in the Four Largest Economies

Notes: Shares are final spending in each sector divided by the sum of total investment spending and consumption spending. See Appendix Section A for details.

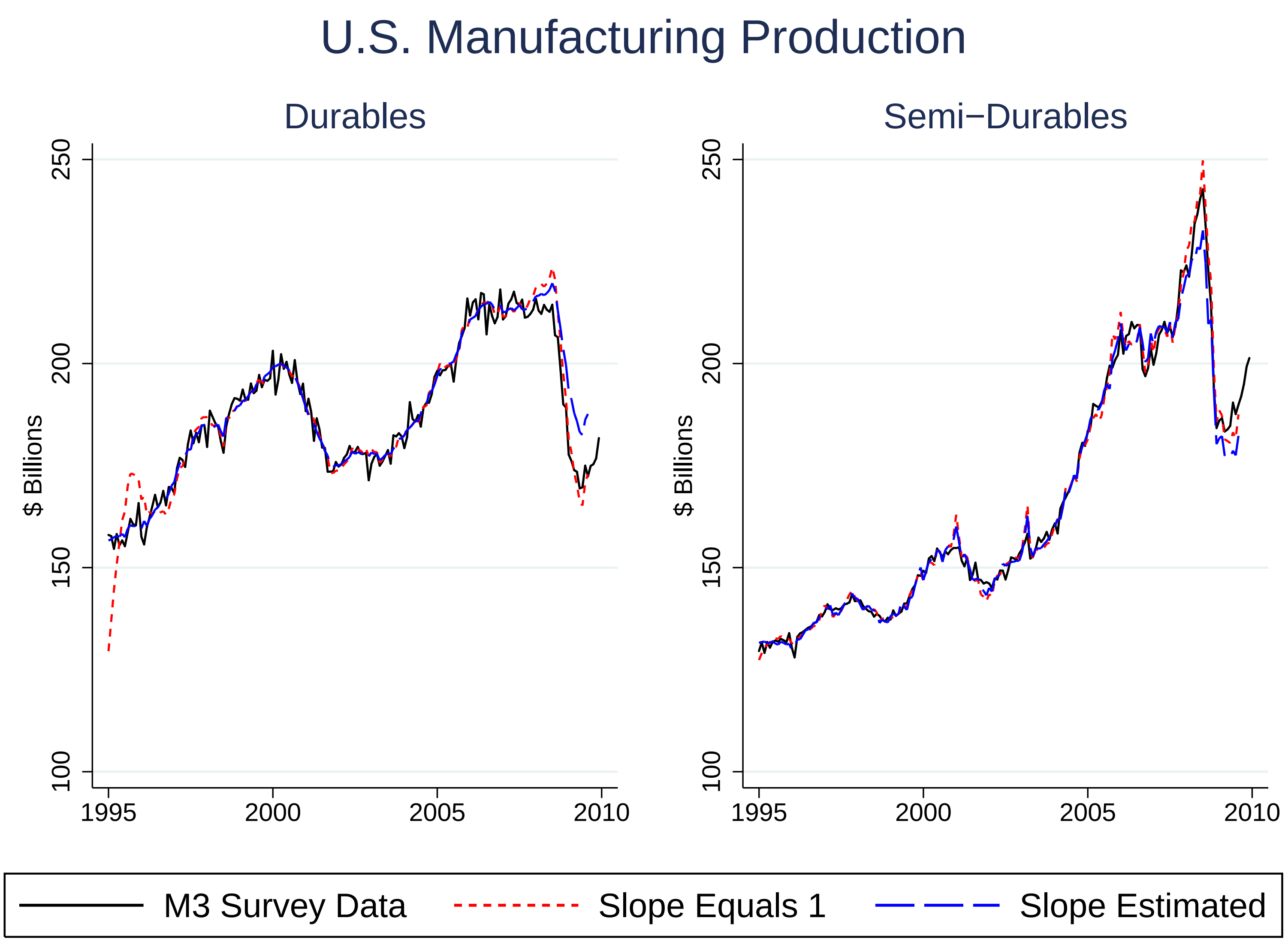

Figure A.9: Checking Accuracy of Temporal Disaggregation Procedure for United States

Notes: Checking procedure with durables (AMDMVS) and nondurables (AMNMVS) series from Federal Reserve M3 survey (note this is different source from analysis in paper). Annual totals included from 1995-2007 only, even though data starts earlier and is available through 2009, to mirror extent of data used for other countries.