EXAMPLES OF COUNTERFACTUALS USING DYNAMIC HAT ALGEBRA

In this appendix, we discuss what type of questions can be answered using the dynamic hat algebra methodology, and what measurements are required to do so. Overall, the results from Propositions 2 and 3 can be applied to study different type of counterfactuals: i) simulate an economy that is not in steady state in a given year, and where agents expect no further changes in fundamentals going forward; ii) simulate an economy that is not in steady state in a given year, and where agents anticipate the actual changes in fundamentals going forward; iii) compute the changes in allocations in an economy where agents anticipate
the actual changes in fundamentals but a subset of fundamentals changes in a different way relative to the true changes; iv) compute the changes in allocations in an economy where agents do not expect changes in fundamentals but a subset of fundamentals surprisingly increases (or falls) in a given period; v) compute the changes in allocations in an economy where agents do not anticipate the actual change in a subset of fundamentals in a given period; vi) compute the changes in allocations in an economy where agents anticipated the actual changes in fundamentals but the change in a subset of fundamentals did not happen. The last example is the type of counterfactual we study in the empirical part of the paper to evaluate the effects of the China shock. In what follows, we describe how to compute the equilibrium changes in allocations in each of the first five type of counterfactuals, and their measurement requirements.

To do so, we study different examples of the type counterfactuals described above. In Example 1 we study dynamics with constant fundamentals. Concretely we answer the question: how would the U.S. economy evolve over time, and what would its long-run features be, given the fundamentals in the initial period? We also answer the question: how would the U.S. economy evolve over time, and what would its long-run features be, if agents anticipated the actual changes in fundamentals over the period 2000-2007? In Example 2, we show how to study the effects of unexpected changes in fundamentals relative to constant fundamentals. In particular, we answer the following question: what would have happened across U.S. labor markets if Chinese fundamental productivity instead of growing as it did, it would have grown 20 percent less in each manufacturing sector per year from 2000 to 2007? In Example 3 we show how to study the effects of unexpected changes in fundamentals relative to actual changes in fundamentals. In particular we study the question: what would have happened to the U.S. economy if Chinese fundamental productivity in the manufacturing sector surprisingly grew 20 percent but agents expected no changes? Finally, in Example 4 we study the effects of actual changes in fundamentals. Concretely, we answer the question: what would have happened if agents expected constant fundamentals and unexpectedly Chinese productivity grew as it did?

For all of the examples presented in this appendix we use the data described in Section 4 of the paper. Also, as in the paper, we use a version of the model with 50 U.S. states, 37 other countries, including China, and a constructed rest of the world. For further details, see Section 4 in the main text of the paper.
EXAMPLE 1: DYNAMICS WITH CONSTANT FUNDAMENTALS

The Evolution of the U.S. Economy with Constant year 2000 Fundamentals

We start by describing the evolution of the U.S. economy with constant fundamentals. In particular, in this section we answer the question: how would the economy evolve over time, and what would its long-run features be, given the fundamentals in the initial period? To do so, we simulate the economy with constant fundamentals using the results from Proposition 2. In order to take the model to the data we need to input the set of constant parameters given by the value added shares \( \gamma_{nj} \), the labor shares in value added \( (1-\xi^n) \), the input-output coefficients \( \gamma_{nk,nj} \), the portfolio shares \( \nu^n \), the final consumption expenditure shares \( \xi_j \), the trade elasticities \( \theta \), the discount factor \( \beta \), and the migration elasticity \( \nu \). This set of parameters are needed for all the examples that we present in this appendix. In addition, since we are computing a world with constant fundamentals, we need the cross-sectional data on employment, trade flows, expenditures, and migration flows for the year 2000, namely \( (L_0, \pi_0, X_0, \mu_{-1}) \). In what follows, we describe the changes in allocations in the U.S. economy predicted by our model.

As discussed in the main text, one implication of Proposition 2 is that in steady state the value functions in time differences must converge to zero, or \( \dot{u}_{nj}^{SS} = 1 \) for all labor markets. To illustrate this point, Figure 1 shows the evolution of the time-difference in the value functions for the U.S. economy starting in the year 2000.

![Fig. 1: Value Functions with Constant Fundamentals](image)

Note: The figure presents the evolution of the value functions in time differences for each labor market.

We now turn to describe the changes in allocations in the simulated model with constant fundamentals. Starting with sectoral employment, the upper-left panel in Figure 2 presents
the dynamic response of the manufacturing share of employment. We find that in the absence of changes in fundamentals from the year 2000 and thereafter, the manufacturing employment share falls by about 1.25 percentage points, from about 16.5 percent in the year 2000 to about 15.3 percent in steady state. As shown in the other three panels of Figure 2, the employment share in the wholesale and retail industry declines by a bit more than 0.1 percentage point. On the other hand, workers relocate mainly to services, which experience an increase in its employment share by about 1.22 percentage points, and the employment share in construction slightly increases in steady state. It is worth emphasizing that the model generates transitional dynamics toward a steady-state equilibrium even in the absence of any changes to fundamentals, and that these dynamics occur because the economy is not in a steady state in the year 2000. In other words, the observed employment in manufacturing in 2000 is the equilibrium result of past changes to fundamentals and as a result, the economy is transitioning to a new steady state.

**FIG. 2: The Evolution of Employment Shares (Example 1 constant 2000 fundamentals)**

Note: The figure presents the evolution of employment in each sector (manufacturing, services, wholesale and retail and construction) over total employment. Total employment excludes farming, utilities, and the public sector. The employment shares are computed from the model with constant year 2000 fundamentals.

We proceed to further explore the decline in manufacturing employment given the year 2000 fundamentals. In particular, we quantify the relative contribution of different sectors
and regions to the decline in the manufacturing share of employment.

**Fig. 3: Manufacturing employment declines (% of total)**

![Bar chart showing the contribution of each manufacturing industry to the total decline in manufacturing employment. The largest contributors are computer and electronics, wood and paper, and machinery and textiles. On the other hand, the furniture and petroleum industries experience an increase in employment.]

Note: The figure presents the contribution of each manufacturing industry to the total reduction in manufacturing employment. The results are computed from the model with constant year 2000 fundamentals.

Figure 3 shows the contribution of each manufacturing industry to the total decline in manufacturing employment. The largest contributors to the decline in manufacturing employment are computer and electronics, and wood and paper, followed by machinery and textiles. On the other hand, the furniture and petroleum industries experience an increase in employment. As discussed above, movements in employment across different industries reflect the fact that the economy is not in steady state in the year 2000 and that the data in the year 2000 contains information on past changes to fundamentals.

Figure 4 presents the contribution of each region to the total decline in manufacturing employment with constant fundamentals. The state that contributes the most is New York, accounting for about 13 percent of the total decline, followed by Ohio and Pennsylvania. In the absence of changes to fundamentals, several states such as Arizona, Kentucky, and Nevada, among others, experience an increase in manufacturing employment.

While Figure 4 shows the spatial distribution of the aggregate decline in manufacturing employment, it is also informative to study the local employment change in each region with constant fundamentals. For instance, even when New York contributes the most to the U.S. manufacturing employment decline, part of it could be because it concentrates a large fraction of U.S. manufacturing employment. However, as discussed in the main text, larger regions also tend to be more diversified, that is, employment and production are also important in other sectors, such as services. Therefore, although their contribution to the aggregate decline in manufacturing employment is large, the local impact could be mitigated compared with smaller and less diversified regions where manufacturing represents a higher
**Fig. 4:** Regional contribution to U.S. aggregate manufacturing employment decline (%)

Note: The figure presents the contribution of each state to the total reduction of employment in the manufacturing sector. The results are computed from the model with constant 2000 fundamentals.

**Fig. 5:** Regional contribution to U.S. agg. mfg. emp. decline normalized by regional emp. share

Note: The figure presents the contribution of each state to the U.S. aggregate reduction in the manufacturing sector employment normalized by the employment of each state relative to the U.S. aggregate employment. The results are computed from the model with constant year 2000 fundamentals.

This local impact is shown in Figure 5, which displays the regional contribution to the total decline in manufacturing employment normalized by the employment share of the state in the U.S. economy. As we can see from this figure, the local
impact in manufacturing employment in larger states such as New York and Pennsylvania is smaller than in other less diversified states such as South Dakota or Missouri.

**Fig. 6: Non-manufacturing employment increases (% of total)**

Note: The figure presents the contribution of each non-manufacturing sector to the total increase in the non-manufacturing employment. The results are computed from the model with constant year 2000 fundamentals.

**Fig. 7: Regional contribution to U.S. aggregate non-manufacturing employment increase (%)**

Note: The figure presents the contribution of each state to the total rise in the non-manufacturing employment. The results are computed from the model with constant year 2000 fundamentals.

We now turn to describe the sectoral and spatial distribution of the employment gains in the non-manufacturing industries with constant fundamentals. The sectoral contribution to the change in non-manufacturing employment is displayed in Figure 6. We find that with constant fundamentals employment relocates to only a few sectors, namely construction, real estate, health, accommodation and other services. All the rest of the non-manufacturing
sectors experience a decline in their employment shares. As discussed above, the changes in employment shares in non-manufacturing industries result from the fact that the economy was not in steady state in the year 2000. Figure 7 shows that across regions, Florida explains most of the increase in non-manufacturing employment. Notably, the figure suggests that if fundamentals would have stayed constant in the U.S. economy at the year 2000 level, New York would have experienced a large decline in employment in the services industry, and households would have relocated to other states as a result.


We now describe the evolution of the U.S. economy with time varying fundamentals from 2000 to 2007 and constant fundamentals from 2007 and thereafter. In particular, in this section we answer the question: how would the economy evolve over time, and what would its long-run features be, if agents anticipated the actual changes in fundamentals over the period 2000-2007?

To do so, we take the model to the data using time series data on employment, migration flows, trade flows, and expenditures over the period 2000-2007, namely \( \{L_t, \mu_{t-1}, \pi_t, X_t\}_{t=2000}^{2007} \). We then simulate the economy with constant fundamentals after 2007 using the results from Proposition 2. In what follows, we describe the change in allocations predicted by our model with time-varying fundamentals. As discussed in the main text, we do not need to know the level or the actual evolution of the fundamentals from 2000 to 2007 to compute this counterfactual example.

Starting with sectoral employment, the upper-left panel in Figure 8 presents the dynamic response of the manufacturing share of employment. We find that the manufacturing employment share declines from 16.5 percent in 2000 to about 13.7 percent in steady state or by about 2.8 percentage points. Therefore, we find a larger fall in the manufacturing employment share compared to the simulated economy with constant fundamentals.

The larger manufacturing employment decline with time-varying fundamentals suggests that the past changes in fundamentals, as well as the actual changes in fundamentals over the period 2000-2007 resulted in a steady fall in manufacturing employment. In this context, constant fundamentals slow this falling path, which explains why the steady state manufacturing employment share is larger with constant fundamentals. As shown in the other three panels of Figure 8, the larger fall in manufacturing employment with time-varying fundamentals results in a larger relocation of workers to construction and services compared with an economy with constant fundamentals.

Turning to the sectoral contribution to the decline in manufacturing employment shares,
FIG. 8: The Evolution of Employment Shares (Example 1 time varying 2000-2007 fundamentals)

Note: The figure presents the evolution of employment in each sector (manufacturing, services, wholesale and retail and construction) over total employment. Total employment excludes farming, utilities, and the public sector. The employment shares are computed from the model with the actual change in fundamentals over 2000-2007.

Figure 9 shows that the largest contributors are computers and electronics, wood and paper, and textiles. On the other hand, the food beverage and tobacco, petroleum and non-metallic industries experience an increase in their employment shares with time-varying fundamentals.

Across regions, Figure 10 shows that with time varying fundamentals the states that contribute the most to the decline in manufacturing employment are Alabama, California, Illinois, and Pennsylvania. It is worth mentioning that the relative contribution of different states is different from the one in an economy with constant fundamentals, suggesting heterogeneity in the actual change to fundamentals across space over 2000-2007.

When normalizing by the regional employment shares in Figure 11, and analogous to the case with constant fundamentals, we find that the relative local impact on larger and more diversified regions is smaller, while the local impact in less diversified states such as Alabama remains large relative to other states.

We now turn to describe the sectoral and spatial distribution of the employment gains in the non-manufacturing industries with time-varying fundamentals. The sectoral contribution
Note: The figure presents the contribution of each manufacturing industry to the total reduction in the manufacturing employment. The results are computed from the model with the actual changes in fundamentals over 2000-2007.

Fig. 9: Manufacturing employment declines (% of total)

Fig. 10: Regional contribution to U.S. aggregate manufacturing employment decline (%)

Note: The figure presents the contribution of each state to the total reduction of employment in the manufacturing sector. The results are computed from the model with the actual changes in fundamentals over 2000-2007.

to the change in non-manufacturing employment is displayed in Figure 12. Similar to the case with constant fundamentals, we find that the increase in non-manufacturing employment is localized in a few industries; construction, education, health, accommodation, and other services. However, the relative contribution of each industry with time-varying fundamentals is also different to that with constant fundamentals, pointing to the heterogeneity of the changes in fundamentals across industries.
Figure 11: Regional contribution to U.S. aggregate manufacturing employment decline normalized by regional employment share

<table>
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<tr>
<th>State</th>
<th>Contribution to Agg. Decline</th>
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<tr>
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<tr>
<td>Arizona</td>
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<tr>
<td>Arkansas</td>
<td>4</td>
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<tr>
<td>California</td>
<td>6</td>
</tr>
<tr>
<td>Colorado</td>
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</tr>
<tr>
<td>Connecticut</td>
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</tr>
<tr>
<td>Delaware</td>
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<td>Florida</td>
<td>2</td>
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Note: The figure presents the contribution of each state to the U.S. aggregate reduction in the manufacturing sector employment normalized by the employment of each state relative to the U.S. aggregate employment. The results are computed from the model with the actual changes in fundamentals over 2000-2007.

The same conclusion emerges when looking at the regional contribution to the increase in non-manufacturing employment with time-varying fundamentals showed in Figure 13. The relative changes in non-manufacturing employment are also different compared with the economy with constant fundamentals highlighting the effects of time-varying fundamentals. Overall, we find that the region that contributes the most to the increase in employment in non-manufacturing industries is Texas, followed by Florida.

**EXAMPLE 2: UNEXPECTED CHANGE IN FUNDAMENTALS RELATIVE TO CONSTANT FUNDAMENTALS**

**With Constant Fundamentals, What if Chinese Fundamental Productivity Unexpectedly Grew 20% per year (00-07)?**

We now apply the results from Proposition 3 to answer the following question: what would have happened to the U.S. economy if Chinese fundamental productivity, $A_t^{ij}$, in the manufacturing sector surprisingly grew 20% but agents expected no changes? The results from Proposition 3 show that in order to conduct this counterfactual we need first to compute the baseline economy with constant fundamentals as we did in Example 1. Similar to the previous example, we do not need to measure the shock since this is a hypothetical 20%
Fig. 12: Non-manufacturing employment increases (% of total)

Note: The figure presents the contribution of each non-manufacturing sector to the total increase in the non-manufacturing employment. The results are computed from the model with the actual changes in fundamentals over 2000-2007.

Fig. 13: Regional contribution to U.S. aggregate non-manufacturing employment increase (%)

Note: The figure presents the contribution of each state to the total rise in the non-manufacturing employment. The results are computed from the model with the actual changes in fundamentals over 2000-2007.
increase in fundamental productivity.

As in the previous example, we start by describing the evolution of the employment shares. Figure 14 shows the dynamics of employment shares. The solid lines show the evolution of employment shares in the baseline economy with constant fundamentals described in Example 1, and the dashed lines show the evolution of employment shares in the counterfactual economy with a 20% productivity growth in China.

**Fig. 14: The Evolution of Employment Shares (Example 2)**

Note: The figure presents the evolution of employment in each sector (manufacturing, services, wholesale and retail and construction) over total employment. Total employment excludes farming, utilities, and the public sector. The dashed lines represent the shares computed from a counterfactual with constant fundamentals and an unexpected 20 percent fundamental TFP increase in all sectors in China per year from 2000-2007. The solid lines represent the shares from the economy with constant 2000 fundamentals.

As before, the difference between both lines, displayed in Figure 15, shows the effects on employment shares of a 20% productivity growth in China. We find that the manufacturing employment share declines by about 0.42 percentage points in steady state as a consequence of the increased import competition from China due to the productivity growth in the manufacturing industry. As shown in the other three panels workers relocate mainly to services whose employment share increases by 0.35 percentage points, while the employment shares in construction and wholesale and retail are slightly higher with the productivity growth in China.
Fig. 15: Counterfactual Effects on Employment Shares (Example 2)

Note: The figure presents the effects, measured as the change in employment shares by sector (manufacturing, services, wholesale and retail, construction) over total employment, from a counterfactual with all fundamentals constant except for a 20 percent annual growth in China’s fundamental TFP over the period 2000-2007.

In Figure 16 we present the relative contribution of each manufacturing industry to the total decline in manufacturing employment with the productivity growth in China. We find that the computer and electronics industry accounts for about 43 percent of the total decline in manufacturing employment, followed by the metals, furniture, and textile industries, that together explain about 45 percent of the decline in U.S. manufacturing employment share.

Figure 17 shows the regional contribution to the decline in U.S. manufacturing employment due to the productivity growth in China. We find that California is the largest contributor and accounts for about 13 percent of the total decline in manufacturing employment followed by Texas that contributes with about 7 percent.

In Figure 18 we study the local impact of the productivity growth in Chinese manufacturing industries by normalizing the regional contributions by the regional employment shares. We find that the local impact in larger and more diversified states such as California and Texas becomes smaller relative to other less diversified states such as North Carolina, South Carolina, Rhode Island, and New Hampshire.

Turning to the results for non-manufacturing industries, in Figure 19 we present the con-
Fig. 16: Manufacturing employment declines (% of total)

Note: The figure presents the contribution of each manufacturing industry to the total reduction in the manufacturing employment. The results presented are the effects of an unexpected 20 percent fundamental TFP increase in all manufacturing sectors in China per year from 2000-2007 relative to a baseline with constant 2000 fundamentals.

Fig. 17: Regional contribution to U.S. aggregate manufacturing employment decline (%)

Note: The figure presents the contribution of each state to the total reduction of employment in the manufacturing sector. The results presented are the effects of an unexpected 20 percent fundamental TFP increase in all manufacturing sectors in China per year from 2000-2007 relative to a baseline with constant 2000 fundamentals.

tribution of different industries to the increase in U.S. employment in non-manufacturing industries. We find that besides the category other services, the health industry is the largest contributor among services industries, accounting for about 22 percent of the total increase in non-manufacturing employment share, followed by education, and construction, which together account for an about 22 percent of the U.S. decline in non-manufacturing employment shares. Overall, we find that all non-manufacturing industries absorbed workers.
Figure 18: Regional contribution to U.S. aggregate manufacturing employment decline normalized by regional employment share.

Note: The figure presents the contribution of each state to the U.S. aggregate reduction in the manufacturing sector employment normalized by the employment of each state relative to the U.S. aggregate employment. The results presented are the effects of an unexpected 20 percent fundamental TFP increase in all manufacturing sectors in China per year from 2000-2007 relative to a baseline with constant 2000 fundamentals.

displaced from the manufacturing industries.

Figure 20 presents the contribution across states to the total non-manufacturing employment increase. Similar to the previous example, states with a larger services sectors such as California and New York, contribute more to the total change in non-manufacturing employment. In particular, the largest contributor is New York that accounts for about 13 percent of the total increase in U.S. non-manufacturing employment, followed by California.

EXAMPLE 3: UNEXPECTED CHANGE IN FUNDAMENTALS RELATIVE TO ACTUAL FUNDAMENTALS

What if Chinese Fundamental Productivity had Grown 20% Less in Each Manufacturing Sector?

We now apply the results from Proposition 3 to answer a different counterfactual question: what would have happened across U.S. labor markets if Chinese fundamental productivity, $A_{ij}$, instead of growing as it did, it would have grown 20% less in each manufacturing sector per year from 2000 to 2007? The results from Proposition 3 show that in order to conduct this counterfactual we need data on the factual baseline economy, but we do not need to
Fig. 19: Non-manufacturing employment increases (% of total)

Note: The figure presents the contribution of each non-manufacturing sector to the total increase in the non-manufacturing employment. The results presented are the effects of an unexpected 20 percent fundamental TFP increase in all manufacturing sectors in China per year from 2000-2007 relative to a baseline with constant 2000 fundamentals.

Fig. 20: Regional contribution to U.S. aggregate non-manufacturing employment increase (%)

Note: The figure presents the contribution of each state to the total rise in the non-manufacturing employment. The results presented are the effects of an unexpected 20 percent fundamental TFP increase in all manufacturing sectors in China per year from 2000-2007 relative to a baseline with constant 2000 fundamentals.
measure the shock since this is a hypothetical 20% reduction in fundamental productivity relative to the actual one.

Fig. 21: The Evolution of Employment Shares (Example 3)

Note: The figure presents the evolution of employment in each sector (manufacturing, services, wholesale and retail and construction) over total employment. Total employment excludes farming, utilities, and the public sector. The dashed lines represent the shares computed from a counterfactual with all the actual changes in fundamentals except for a 20 percent less growth in China’s fundamental TFP per year relative to the actual growth in China’s TFP over the period 2000 to 2007. The solid lines represent the shares from the actual economy.

As before, we start by describing the evolution of the employment shares. Figure 21 shows the dynamics of employment shares in manufacturing, services, wholesale and retail, and construction. The solid lines show the evolution of employment shares in the factual baseline economy described in Example 1, that is, with the actual changes in fundamentals over 2000-2007. The dashed line shows the evolution of employment shares in the counterfactual economy with 20% less productivity growth in China.

The difference between both lines, displayed in Figure 22, shows the effects on employment shares of a 20% less productivity growth in China. Starting with the first panel, we find that the manufacturing employment share increases by about 0.27 percentage points in steady state as a consequence of reduced import competition from China due to its slower produc-
Fig. 22: Counterfactual Effects on Employment Shares (Example 3)

Note: The figure presents the effects, measured as the change in employment shares by sector (manufacturing, services, wholesale and retail and construction) over total employment, computed from a counterfactual with all the actual changes in fundamentals except for a 20 percent less growth in China’s fundamental TFP per year relative to the actual growth in China’s TFP over the period 2000 to 2007.

...ivity growth. The other three panels show that workers relocate mainly from services whose employment share declines by 0.22 percentage points. Employment shares in construction and wholesale and retail are slightly lower with the lower growth in Chinese productivity.

In Figure 23 we present the relative contribution of each manufacturing industry to the total increase in manufacturing employment with 20% less productivity growth in China. We find that the computer and electronics industry is the largest contributor, explaining about 27 percent of the total increase in manufacturing employment, followed by the metals, furniture, and textile industries, that together explain about 45 percent of the increase in U.S. manufacturing employment share.

Figure 24 shows the regional contribution to the increase in U.S. manufacturing employment. California explains about 10 percent of the total increase in manufacturing employment followed by Texas that contributes with about 8.5 percent.

In Figure 25 we study the local impact of a lower productivity growth in Chinese manu-
Fig. 23: Manufacturing employment increases (% of total)

Note: The figure presents the contribution of each manufacturing industry to the total increase in manufacturing employment. The results are computed from a counterfactual with all the actual changes in fundamentals except for a 20 percent less growth in China’s fundamental TFP per year relative to the actual growth in China’s TFP over the period 2000 to 2007.

Fig. 24: Regional contribution to U.S. aggregate manufacturing employment increase (%)

Note: The figure presents the contribution of each state to the total increase in employment in the manufacturing sector. The results are computed from a counterfactual with all the actual changes in fundamentals except for a 20 percent less growth in China’s fundamental TFP per year relative to the actual growth in China’s TFP over the period 2000 to 2007.

Facturing industries by normalizing the regional contributions by the regional employment shares. We find that the local impact in larger and more diversified states such as California and Texas becomes smaller relative to other less diversified states such as Mississippi, North Carolina, and South Carolina.
Fig. 25: Regional contribution to U.S. agg. mfg. emp. increase normalized by regional emp. share

Note: The figure presents the contribution of each state to the U.S. aggregate increase in the manufacturing sector employment normalized by the employment of each state relative to the U.S. aggregate employment. The results are computed from a counterfactual with all the actual changes in fundamentals except for a 20 percent less growth in China’s fundamental TFP per year relative to the actual growth in China’s TFP over the period 2000 to 2007.

Turning to the results for non-manufacturing industries, in Figure 26 we present the contribution of different industries to the U.S. decline in non-manufacturing employment, and Figure 27 presents the contribution across states to the total non-manufacturing employment decline. Starting with Figure 26, we find that besides the category other services, the health industry is the largest contributor among services industries, accounting for about 21 percent of the total decline in non-manufacturing employment share, followed by education, transport services, and construction, with an about 10 percent contribution each. Figure 27 shows that the states with a larger service sector such as California and New York contribute more to the total decline in non-manufacturing employment. In particular, the largest contributor is California that accounts for about 12 percent of the total decline in the non-manufacturing employment share, followed by New York with an about 8 percent contribution.
**Fig. 26:** Non-manufacturing employment declines (% of total)

Note: The figure presents the contribution of each non-manufacturing sector to the total decline in the non-manufacturing employment. The results are computed from a counterfactual with all the actual changes in fundamentals except for a 20 percent less growth in China’s fundamental TFP per year relative to the actual growth in China’s TFP over the period 2000 to 2007.

**Fig. 27:** Regional contribution to U.S. aggregate non-manufacturing employment decline (%) 

Note: The figure presents the contribution of each state to the total decline in the non-manufacturing employment. The results are computed from a counterfactual with all the actual changes in fundamentals except for a 20 percent less growth in China’s fundamental TFP per year relative to the actual growth in China’s TFP over the period 2000 to 2007.
EXAMPLE 4: STUDYING THE EFFECTS OF ACTUAL CHANGES IN FUNDAMENTALS

With Constant Fundamentals, What is the Impact of the Actual China Shock?

We now quantify the dynamic effects of China’s import competition on the U.S. economy with constant fundamentals. We first compute the dynamic model, holding all fundamentals constant, which is our baseline economy. We do this using the results from Proposition 2, assuming that agents foresee constant fundamentals over time, as we did in Example 1. We then use the results from Proposition 3, and solve for the changes in equilibrium allocations due to the China shock. Different to the previous example, in order to perform this counterfactual, we need to measure the \textit{change in fundamentals} that we want to study; in this case the change in fundamentals that define the China shock.

If we need a measure of the actual changes in the fundamental that we want to evaluate, one alternative could be to obtain estimates from the literature. Another approach is using the model to estimate the change in fundamentals. In either case, the next section presents an example of how to apply our method to evaluate the effects of actual changes to fundamentals. Before doing so, we briefly describe our approach to measure the China shock for this particular counterfactual example.

\textbf{Measuring the China Trade Shock.—}

In the case of the study of the economic effects of the China shock, an alternative is to use estimates of changes in Chinese manufacturing TFP computed by national agencies. Unfortunately, such estimates are not readily available for our level of aggregation and time period. As a result, we follow a different route and compute the change in productivities in China in manufacturing industries that match the change in U.S. imports from China from the year 2000 to 2007. Of course, the change in imports over this period could have been the consequence of factors other than changes in Chinese productivity. To deal with this, we rely on the identification strategy proposed by ADH. Section 4.1 in the main text presents further details.

Concretely we solve for the change in China’s TFP in our twelve manufacturing industries \( \{ \hat{A}_{t,Ch}^{Ch,j} \}_{j=1,t=2000}^{12,2007} \) such that the model predicted imports match the predicted imports from China from 2000 to 2007 from the first-stage ADH regression. Different from Section 4.1 in the main text, the model that we use to measure the changes in productivities in China is the model that has a baseline economy with constant fundamentals, and a counterfactual economy where agents expected constant fundamentals but Chinese TFPs unexpectedly grew. Our loss function is the sum square of the differences between the model implied
changes in U.S. imports from China from 2000 to 2007 and the predicted changes in U.S. imports from China from the ADH first-stage regression. This procedure takes time given the high dimensionality of our problem. We used as a starting guess, the changes Chinese manufacturing productivities that solve a static version of our model. Using this as an initial condition turns out to be a smart guess. Figure 28 shows the predicted change in U.S. manufacturing imports from China computed as in ADH and the implied sectoral productivity changes in China.

Results.—

Starting with sectoral employment, Figure 29 presents the dynamic response of employment shares due to the China shock with all other fundamentals constant. In particular, the figure shows the difference between our baseline economy with constant fundamentals and a counterfactual economy with the actual changes productivities in China.

The upper-left panel in Figure 29 shows the transitional dynamics of manufacturing employment due to the China shock. The figure shows that import competition from China contributed to a decline in the share of manufacturing employment of about 0.5 percentage point in the long run.

As shown in the other three panels of Figure 29, increased import competition from China leads workers to relocate to other sectors; thus, the share of employment in services, wholesale and retail, and construction increases. We also find that Chinese competition reduced the
U.S. non-employment rate by 0.25 percentage point in the long run. The role of intermediate inputs and sectoral linkages is crucial to understanding these relocation effects. Import competition from China leads to decreased production among U.S. manufacturing sectors that compete with China, but it also affords the U.S. economy access to cheaper intermediate goods from China that are used as inputs in non-manufacturing sectors. Production and employment increase in the non-manufacturing sectors as a result. Moreover, the increase in employment in these sectors more than offsets the decline in manufacturing employment so that the non-employment rate declines.

Fig. 29: Counterfactual Effects on Employment Shares (Example 4)

Note: The figure presents the effects, measured as the change in employment shares by sector (manufacturing, services, wholesale and retail and construction) over total employment, from a counterfactual without the China shock and constant fundamentals relative to the economy with constant fundamentals and with the China shock.

Finally, employment in construction declines a bit in the short run after the China shock, which is explained, as mentioned earlier, by the fact that the economy was transitioning to a steady state when the change in Chinese productivity hit the U.S. economy. In the long run, we find that about 75 thousand jobs were created in construction as a result of the China shock.

Figure 30 presents the dynamic response of the shares of employment both with and without the China shock. As discussed above, there are transitional dynamics toward a
steady-state equilibrium even in the absence of any change in Chinese productivity, and these dynamics occur because the economy is not in a steady state in the year 2000.

**Fig. 30: The Evolution of Employment Shares (Example 4)**

Note: The figure presents the evolution of employment in each sector (manufacturing, services, wholesale and retail, and construction) over total employment. Total employment excludes farming, utilities, and the public sector. The solid lines represent the shares from the baseline economy with constant fundamentals, while the dashed lines represent the shares from the economy with the China shock.

We now quantify the relative contribution of different sectors, regions, to the decline in the manufacturing share of employment due to the China shock. Figure 31 shows the contribution of each manufacturing industry to the total decline in the manufacturing sector employment. Industries with higher exposure to import competition from China lost more employment. The computer and electronics and furniture industries contributed to about half of the decline in manufacturing employment, followed by the metal and textiles industries, which together contributed to about one-fourth of the total decline. Industries less exposed to import competition from China explain a smaller portion of the decline in manufacturing employment. In fact, these industries also benefit from access to cheaper intermediate goods from industries that experienced a substantial productivity increase in China. In some industries, such as food, beverage, and tobacco, increased production from access to cheaper intermediate goods more than offset the negative effects of increased import competition, and employment increased as a result.
As discussed in the main text, the fact that the U.S. economic activity is not equally distributed across space, combined with its differential sectoral exposure to China, implies that the impact of import competition from China on manufacturing employment varies across regions. Accordingly, Figure 32 presents the regional contribution to the total decline in manufacturing employment. Similar to the results in the main text, states with a comparative advantage in industries more exposed to import competition from China lose more employment in manufacturing. As a result, California, which concentrates a large fraction of the employment in the computer and electronics industry, is the state that contributed the most to the overall decline in manufacturing employment (about 12%) followed by Texas. States with a comparative advantage in goods that were less affected by import competition from China and states that benefited from the access to cheaper intermediate goods showed a smaller impact on employment.

While Figure 32 shows the spatial distribution of the aggregate decline in manufacturing employment, it is also informative to study the local impact in each region of the China shock. As discussed in the main text, larger regions such as California are more exposed to the China shock because they concentrate a large fraction of U.S. employment in industries that have high exposure to foreign trade, larger regions also tend to be more diversified. That is, employment and production are also important in other sectors, such as services, with little direct exposure to trade. Therefore, although their contribution to the aggregate decline in manufacturing is large, the local impact of the China shock could be mitigated compared with smaller and less diversified regions where manufacturing represents a higher share of local employment.

This local impact is shown in Figure 33, which displays the regional contribution to the
Fig. 32: Regional contribution to U.S. aggregate manufacturing employment decline (%)

Note: The figure presents the contribution of each state to the total reduction of employment in the manufacturing sector due to the China shock.

Fig. 33: Regional contribution to U.S. agg. mfg. emp. decline normalized by regional emp. share

Note: The figure presents the contribution of each state to the U.S. aggregate reduction in the manufacturing sector employment, due to the China shock, normalized by the employment of each state relative to the U.S. aggregate employment.
total decline in manufacturing employment normalized by the employment share of the state in the U.S. economy. In the figure, a number greater than one means that the local change in manufacturing employment share is larger than the national change (-0.5 percentage points). As we can see from this figure, the local impact in manufacturing employment in states like South Carolina and North Carolina was bigger than the impact for the whole U.S. economy. The figure also shows that in other bigger and more diversified states, such as California and Texas, the decline in manufacturing employment as a share of the state employment is similar to the aggregate U.S. decline in manufacturing employment share.

**Fig. 34:** Non-manufacturing employment increases (% of total) due to the China trade shock

Note: The figure presents the contribution of each non-manufacturing sector to the total increase in the non-manufacturing employment due to the China shock.

We now turn to the sectoral and spatial distribution of the employment gains in the non-manufacturing industries due to the China shock. The sectoral contribution to the change in non-manufacturing employment is displayed in Figure 34. As we can see, all non-manufacturing industries absorbed workers displaced from manufacturing industries. In particular, besides the category other services, the health and education industries are the largest contributors among service industries, accounting for about 35 percent of the change in non-manufacturing employment share, followed by construction with a 10 percent contribution. Figure 35 shows that U.S. states with a larger service sector contribute more to the increase in non-manufacturing employment as they were able to absorb more workers displaced from the manufacturing industries. Specifically, New York is the largest contributor, accounting for about 9 percent of the total increase in non-manufacturing employment, followed by California, which accounts for about 8 percent.
Fig. 35: Regional contribution to U.S. aggregate non-manufacturing employment increase (%) 

Note: The figure presents the contribution of each state to the total rise in the non-manufacturing employment due to the China shock.