Revitalize or Relocate:

Optimal Place Based Transfers for Local Recessions

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Cities go through recessions. How does the national government respond to these downturns? And how should it? I provide evidence that commuting zones in the US are subject to idiosyncratic shocks and that population and wages respond only slowly in the aftermath. The US government picks up the slack by transferring money to the affected region through various taxes and public assistance programs. I then present a two-period model of local recessions where I characterize the optimal fiscal policy to achieve macroeconomic stability. Transfers have both a stimulus effect—boosting local demand through home-biased consumption—and a migration effect—encouraging residents to stay, exacerbating the recession. A dynamic New Keynesian economic geography model calibrated to US commuting zones suggests that transfers should be much more generous immediately after a shock, followed by possible taxes in the medium run. The China trade shock, on the other hand, calls for more aggressive transfers targeted towards both the directly impacted and nearby regions.

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1 Introduction

The Janesville Assembly Plant produced its final car for GM on December 23, 2008.[1] In the following months and years, large numbers of workers lost their jobs. And though a large factory stood empty and many people were willing to work for low wages, no new company moved in to offer lower wages and lots of jobs. Instead, the area fell into a deep recession–a deeper recession than the rest of the US. This is not an isolated case but an example of something that affects regions all around the world. Autor et al. (2013) report widespread unemployment in regions of the United States that compete directly with Chinese goods, and Topalova (2010) and Dix-Carneiro (2014) note similar transitional pain for regions exposed to foreign competition in India and Brazil, respectively.

These local recessions pose a problem for macroeconomic policy. The traditional tool for fighting recessions is monetary policy, however these hard-hit cities within large nations do not have their own currency. In order to jump start the economy in one city, the government would have to overheat another city. Kenen (1969) offers a solution for a similar problem facing currency unions like the European Union: fiscal policy. If one country is in a recession, a centralized authority can increase spending there through fiscal transfers. Since people spend much of their money locally, that will stimulate the local economy without stimulating the whole currency union. But within a country like the United States, there is an added wrinkle since people move more frequently. Should the central government still use fiscal policy to fight local recessions in this setting? And if so, what should those transfers look like?

In this paper, I shed new light on these questions with three contributions. First, I provide new empirical evidence that local recessions matter in the US and that the national and state governments transfer money to regions after a shock through a variety of tax and transfer programs. Second, I propose a simple economic geography model of local recessions and use it to illustrate the key trade-offs in designing optimal fiscal policy. Finally, I quantify these forces using a dynamic New Keynesian economic geography model, showing what the optimal policy should look like and demonstrating the welfare gains from implementing it.

I start by documenting a few descriptive facts about local recessions in the United States. I decompose the unemployment rate across commuting zones into a long-run commuting zone component, an aggregate business cycle component, and an unexplained component. 53% of the observed variation can be explained by long-run differences across commuting zones, and 25% by the aggregate business cycle. That leaves a little more than 21% of unemployment

[1] See Goldstein (2017) for a moving account of what happened to Janesville, Wisconsin after the factory closed.

unexplained. Thus, for an individual commuting zone, idiosyncratic shocks are almost as important for explaining its changes in unemployment as the nation-wide business cycle.

I then use local projection methods to illustrate how a US commuting zone adjusts to an innovation in local unemployment. Controlling for detailed demographic information and the number of weeks worked, log wage earnings drop slowly after a sudden increase in unemployment. Wages drop for 4 years before recovering, consistent with a story of sticky wages. Population, on the other hand, drops and never recovers. The government does not stand idle. In line with Kenen (1969)'s recommendations, the federal government transfers money through social programs and lower tax rates. Transfers increase by around 3.5% of a commuting zone's original income after the unemployment rate jumps by 10 percentage points. The transfers then slowly decline over the next 15 years.

In the second part of the paper, I turn to assess how effective those transfers are in fighting local recessions. I propose a two-period model of local recessions where wages are perfectly rigid, workers are imperfectly mobile across regions, some goods are non-traded, and a national government can set monetary policy and place-based fiscal transfers. I set up the second-best planner's problem where workers are free to live where they would like (subject to migration frictions) and the planner can tax or subsidize certain areas. While the planner cannot directly move people, it can indirectly influence where people want to live by making certain regions more or less attractive with transfers.

Place-based transfers have two macroeconomic effects: a stimulus effect and a migration effect.[2] The stimulus effect comes from the fact that people spend disproportionately on goods and services near them, and so giving a region money will increase demand in the local area. When wages are rigid, there will be an aggregate demand externality leading to first order welfare benefits, as emphasized by Kenen (1969) and formalized by Farhi and Werning (2017). All other things equal, transferring money from a booming area to a busting area will cool down the booming economy while heating up the area in a recession, efficiently putting people back to work. This role for transfers encourages a planner to redistribute funds towards locations in a recession, even if insurance markets are perfect.

The migration effect emerges because transfers influence where people want to live. If the government gives tax breaks to people living in an area, other people will be more likely to move there, and people already living there will be less likely to move out. When output is demand-determined because wages are sticky, this movement of people will have an important impact on underemployment. Each region produces some traded goods for the country and

[2]Transfers also directly increase utility of people in a region and so have the usual redistribution effect, but that is not my focus in this paper. See Gaubert et al. (2021) and Donald et al. (2023) for in depth discussions of how place-based policy can be used for redistribution.

the amount demanded is independent of local spending and population. Consider the GM factory in Janesville. With sticky prices, it needs to build a certain number of cars to meet the demand of the outside world. It only needs a certain number of man-hours to do that. In the short run, that will not adjust so movement of people in and out of the region will change the population without affecting employment in the traded sector. It could affect employment in the non-traded sector since people moving in have some home bias, but any increase in labor demand from immigration must be smaller than the increase in labor supply because the money coming in through the traded sector is fixed. This force implies that, if anything, the federal government should tax hard-hit areas to encourage people to find jobs somewhere else.

I derive three analytical results that demonstrate how the migration and stimulus effects interact to shape optimal place-based policy. First, I consider what fiscal transfers should be in a small region that just had a negative shock to the demand of its traded output, like Janesville. Starting from a point with no transfers, a transfer to Janesville improves macroeconomic stability if and only if the local multiplier is larger than the elasticity of population to wages (holding fixed labor supply), thus, the optimal transfer could be a tax. This might seem counterintuitive since, when there is no migration, transferring money to a region in a recession always helps stimulate the economy, improving welfare. One might have thought that allowing migration would simply mute that effect. In fact, the migration effect can overturn that result, making a place-based transfer counterproductive. That is because government transfers directly increase utility of living in a location, independent of the stimulus effect, and that increase in utility leads to migration which reduces the employment rate. Therefore, the fully optimal transfer could be positive or negative, depending on the local multiplier and the migration elasticity.

While the previous result provides a clear cut-off to weigh the relative strength of the migration effect versus the stimulus effect, in practice many demand shocks do not hit only one region. Instead, they are spatially correlated. My next result considers what the spatial nature of the shock implies for the optimal transfer. I find that if migrants to and from Janesville disproportionately come from and to areas that are in a recession, then the optimal transfer is larger than that suggested by the local multiplier and the migration semi-elasticity. That is due to the migration effect. If workers disproportionately leave areas in a recession to go to Janesville, that might hurt the recession in Janesville, but it will help the areas that those workers left. Therefore, considering Janesville in a vacuum misses an important effect. When demand shocks are correlated, there might be more scope for the national government to use fiscal transfers to stimulate an entire area.

My final analytical result considers the effects of dynamics on the optimal fiscal transfers.

In particular, I show that the transfer to Janesville in period 2 is smaller than that suggested by the local multiplier and the migration semi-elasticity. This is due to a dynamic migration effect. One might have thought that transfers in the second period would have the same trade-off between the stimulus effect and the migration effect, but because people have more time to move, the migration effect is stronger and so the optimal transfer is smaller. That is not the full story because period 2 transfers not only affect where people live in period 2, but also period 1. If the government has made it clear that it will tax households that are in Janesville in period 2, households that have the opportunity to leave in period 1 will do so. Thus, the planner can encourage out migration in period 1 without losing stimulus.

The final part of the paper uses a dynamic New Keynesian economic geography model to derive the practical implications for optimal fiscal transfers in response to different types of demand shocks. To do so, I move to a continuous time, parametric version of my theoretical model where wages are only partially rigid and there are finite trade costs in the traded sector. I calibrate the model using well-identified parameters from the literature, observed trade flows between states, observed migration flows between commuting zones, and economic activity at the commuting level.

I then consider what optimal fiscal transfers should look like in the aftermath of an idiosyncratic local recession like that considered in the empirical section of this paper. Comparing the optimal policy to observed policy, fiscal transfers should be four times larger immediately after the shock to efficiently put households back to work. However, those transfers should then more quickly scale back. I find that under some reasonable parametrizations, the government should actually tax people in commuting zones 10 years after the shock to encourage out-migration. Observed policy gets only 35% of the welfare gains of optimal policy over no policy at all. Making unemployment insurance much more generous after a commuting zone-wide shock could get much of the welfare gains. Alternatively, the local government could engage in its own fiscal stimulus, borrowing money to jump start the economy, and paying it back over the period 5-20 years after the shock.

While there has been much research on the pain that the China trade shock has wrought, there has been much less research considering what the government should have done. Using my framework, I revisit how the national government could have used fiscal policy to fight against the local recessions that resulted from competition with Chinese exporters. If the planner had anticipated how bad the China shock was going to be, the planner should have taxed people in commuting zones that were hit between 2000 and 2006 so as to encourage them to leave. The planner then gives generous transfers to commuting zones directly impacted by the shock all the way until the year 2024. The migration effect is less important in response to the China shock because it was so spatially correlated. Workers did not have anywhere else to go, so generous transfers for a long period of time can stimulate the economy without distorting migration decisions. Transfers to nearby regions are especially effective since they stimulate the commuting zones that were hit, while encouraging workers to leave their worse hit regions.

The rest of the paper is structured as follows. There is a short Related Literature section below where I mention a number of papers related to the current study. In section 2, I present some basic motivating facts about local recessions and the government policy response. I present the 2-period model of local recession in section 3, before characterizing the optimal policy and teasing out the implications in section 4. The dynamic new Keynesian economic geography model is in section 5. I show what the model implies for optimal policy in response to an idiosyncratic demand to a single commuting zone in section 6, and then in response to the China Trade shock in section 7. I give some concluding remarks in section 8. All proofs of propositions are in the appendix.

Related literature

My paper most directly contributes to the literature on placed-based policy. The study of optimal place-based policies is a large and diverse literature. Numerous empirical papers have explored the effect of place-based policies (see Neumark and Simpson (2015) and Ehrlich and Overman (2020) for reviews). And many theory papers have studied the reason that such policies could be welfare improving. Abdel-Rahman and Anas (2004), Wildasin (1980), Fajgelbaum and Gaubert (2020) and Kline and Moretti (2014) all study how optimal spatial policy could correct for agglomeration externalities. Other papers, such as Gaubert et al. (2021) and Donald et al. (2023), consider re-distributive reasons for place-based policies. I contribute to this literature by considering what place-based policy can do in response to a completely different market failure: local recessions. I show that the implications for optimal policy are very different and the timing of the transfers play an important role.

My paper also contributes to a large empirical literature studying how regions respond to idiosyncratic shocks. Most closely related to my empirical contribution is Blanchard and Katz (1992), who use structural methods to see how states respond to economic shocks. Yagan (2019) shows that states more exposed to the great recession are affected long after the recession ends. Looking at commuting zones, as I do here, Autor et al. (2013) study regions that directly compete with Chinese industries as China starts exporting large numbers of goods. Topalova (2010) analyzes regions in India as tariff barriers came down, and Dix-Carneiro (2014) considers a similar episode in Brazil. Costinot et al. (2022) studies the effect of the collapse of trade between Finland and the USSR on worker outcomes and rationalizes some of the results with a model of wage rigidity. I contribute to this literature by showing how government policy responds to these shocks and finding what optimal policy should look like in the aftermath.

A growing dynamic trade and economic geography literature tries to quantify the welfare impacts of such trade shocks. Galle et al. (2017) and Caliendo et al. (2019) are two such neoclassical examples. Lyon and Waugh (2019) consider the welfare implications when households have imperfect savings tools. Rodríguez-Clare et al. (2020) incorporate price rigidities, and Kim et al. (2023) shows that currency pegs play a key role in explaining the large impact of the China shock. My paper contributes to this literature by embedding a standard new Keynesian sticky wage model into an economic geography model and solving for the optimal fiscal policy.

Finally, my paper also contributes to the Optimal Currency Area (OCA) literature. This literature has emphasized a number of important features of successful currency unions like factor mobility (Mundell, 1961), openness (Mundell, 1961), fiscal integration (Kenen, 1969), and financial integration (Mundell, 1973). My paper formalizes the results from Kenen (1969) when there is significant factor mobility as expressed by Mundell (1961).

The modeling approach in this paper builds on two more recent papers (Farhi and Werning, 2014, 2017), formalizing a lot of the arguments made by the older OCA literature. Farhi and Werning (2017) considers what optimal fiscal policy should look like in a currency unions when people are stuck in a location. Farhi and Werning (2014) shows that mobility in a currency union could either help or do nothing for macroeconomic stability of a region going through a recession. The model in this paper nests Farhi and Werning (2017) and shows that some of the results are overturned when you allow for significant factor mobility. While Farhi and Werning (2014) similarly allows factor mobility in a currency union, my paper's question and focus are different. Farhi and Werning (2014) compares equilibrium migration to the migration a planner would enact if the planner could not transfer money between location, but could control where people live. My paper takes as given that people can live where they want and then solves an optimal reallocation of funds exercise.

2 Motivating facts about local recessions and policy

This section provides a few descriptive facts about commuting zone recessions in the United States. I start by showing that commuting zones are subject to recessions that cannot be explained by nation-wide trends. I then use local projection methods to illustrate how commuting zones adjust. Population and wages fall slowly in the aftermath. And the government picks up the slack through a variety of tax and transfer programs. Details of

Table 1: Unemployment Decomposition.

	$\hat{u}_t$	$\hat{u}_n$	$\hat{\varepsilon}^u_{nt}$
Variance	1.78	3.83	1.52

how I construct the data are in Appendix A.

2.1 Fact 1: They matter.

To get an idea of how important commuting zone-specific recessions are in the United States, I look at the unemployment rate across time and space. I use the Local Area Unemployment Statistics (LAUS) managed by the US Bureau of Labor Statistics to get unemployment and labor force counts by county for 1990-2022, which I then aggregate up to the commuting zone level following Tolbert and Sizer (1996) and Autor and Dorn (2013). Denoting the unemployment rate of commuting zone n in year t by u_{nt}, I run the regression,

$$u_{nt} = u_n + u_t + \varepsilon^u_{nt},$$

where u_n and u_t are commuting zone and year fixed effects respectively, to see how much of the observed variation in unemployment can be explained by the aggregate business cycle, how much is explained by persistent differences across commuting zones, and how much remains unexplained.

I report the variance of the fixed effects and the unexplained component in Table 1. The commuting zone fixed effects explain the most variation by far. However, of the remaining variation, the aggregate business cycle explains just a little more than half (54%). That is, for a given commuting zone, the idiosyncratic economic shocks it faces are just as important as any national shock for determining how far it is from full employment.

2.2 Fact 2: Wages and population adjust... slowly.

While these regional recessions are important, we have little idea what they look like. They are not simply small national recessions since regions are subject to different economic forces and interactions than countries. So I provide some descriptive statistics of how regions respond to idiosyncratic shocks. I identify the start of a local recession by an unexpected increase in local unemployment. I then trace out the impulse response functions of a number of important economic variables using local projection methods.[3] Throughout this section I

[3] These methods were pioneered by Jordà (2005) and have become a standard tool for macroeconomists looking to describe impulse response functions without imposing strong functional form assumptions.

normalize the results to correspond to a 10 percentage point jump in unemployment in the commuting zone.

I start by studying how wages in the region adjust. I get a measure of individual wage earnings along with county of residence, some demographic information, and weeks worked from the Annual Social and Economic Supplements (ASEC) of the Current Population Survey (CPS). I then project wage earnings of individuals in commuting zone n on an innovation in unemployment h periods earlier, controlling for the number of weeks worked. I can then plot how commuting zone wage earnings per work week change after an unexpected increase in unemployment.

My main regression specification is:

$$\log E^w_{i,t+h} = \delta^h \log \text{weeks}_{i,t+h} + \beta_h u_{n(i)t} + \gamma^h_{n(i)} + \gamma^h_t + \sum_{L=1}^{\overline{L}} \gamma^h_{uL} u_{n(i),t-L} + \Gamma^h X_{ith} + \varepsilon^w_{ith},$$

where $E^w_{i,t}$ is the wage earnings of individual i in year t, $\text{week}_{i,t}$ is the number of weeks that individual worked, $u_{n(i)t}$ is the unemployment in i's commuting zone in year t, γ^h_n and γ^h_t are commuting zone and year fixed effects respectively, and X_{ith} is a vector of individual level controls including age, education, race, sex, and industry. Controlling for lagged employment $u_{n(i),t-L}$ takes out the expected path of unemployment, so that β_h identifies the impact of an innovation in unemployment at time t on log wages h periods after. I use $\overline{L} = 2$, though including more (or less) lags does not materially affect the results.

I plot the estimates of β_h in Figure 1a. I find that wages do not move at all the year of the increase in unemployment. Then wages seem to slowly decrease over the following 4 years, before finally leveling off and recovering. This is consistent with a story of very rigid wages that cannot adjust in the immediate aftermath of a demand shock. Instead, the adjustment falls on employment in the short run. In the appendix I show that unemployment spikes and stays high for more than 5 years after.

I next consider how population adjusts in response to an innovation in unemployment. My main specification is

$$\log \ell_{n,t+h} = \beta_h u_{nt} + \gamma^h_n + \gamma^h_{s(n)t} + \sum_{L=1}^{\overline{L}} \gamma^h_{uL} u_{n,t-L} + \varepsilon^\ell_{nth},$$

where $\ell_{n,t+h}$ is the population in commuting zone n h years after t, γ^h_n is a commuting zone fixed effect, and $\gamma^h_{s(n)t}$ is a state-year fixed effect, which I include to control for the fact that US population has seen a secular shift out of the colder Northeast towards the south.[4] Just

[4] I create a separate state for all commuting zones that are in multiple states. None of the results depend

(a) log wage (b) log population

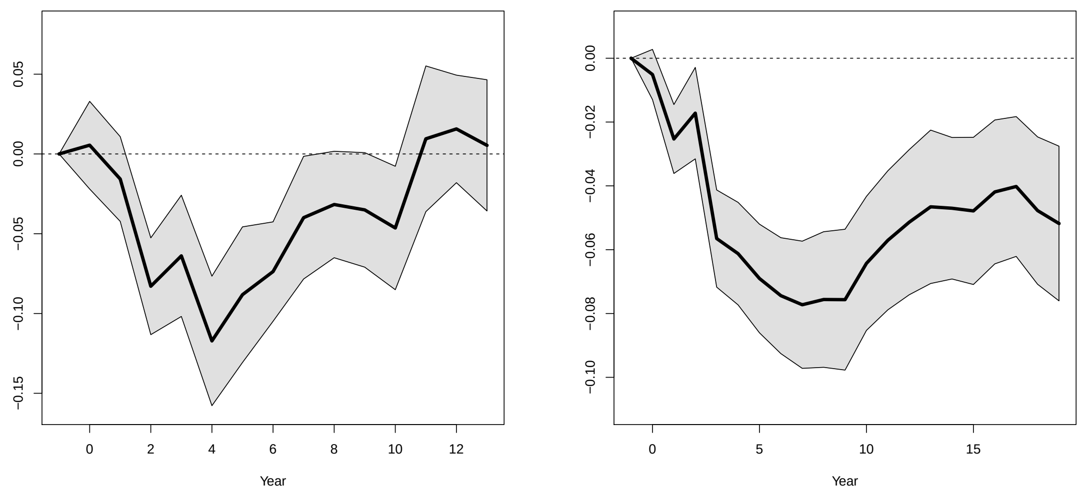


Figure 1: Wage and Population Responses.

Note: Panel a and b plot local Jorda projections of log wages and log population in a commuting zone on innovations in local unemployment, respectively. Results are normalized to correspond to a jump in unemployment of 10 percentage points. Bands indicate 95% confidence intervals clustering on commuting zone.

as before, in my main specification I include 2 years of lagged unemployment ($\overline{L} = 2$), though the main results remain robust including more.

I plot the estimates of β_h in Figure 1b. I find that, consistent with Blanchard and Katz (1992), population drops after the shock, and it never fully recovers. This is in contrast to the findings of Autor et al. (2013) that workers do not leave commuting zones hit hard by the China trade shock. That is likely due to the nature of the shock. The China trade shock not only hurt work opportunities in a particular commuting zone, but it also hurt that worker's opportunities in other nearby regions, as shown in Borusyak et al. (2022). Therefore, workers do not move even though they would in response to a different kind of shock. By contrast, I am considering small, idiosyncratic shocks to individual commuting zones. I will consider how these different types of shocks will affect optimal policy in the theory and quantitative sections.

2.3 Fact 3: The government responds with transfers.

Finally, I turn to how the government currently responds to commuting zone recessions. Using the same projection technique, I first analyze how much money the government sends

on how I handle those commuting zones. The basic pattern also holds if I only use year fixed effects.

(a) Public assistance programs (b) Log income retention rate

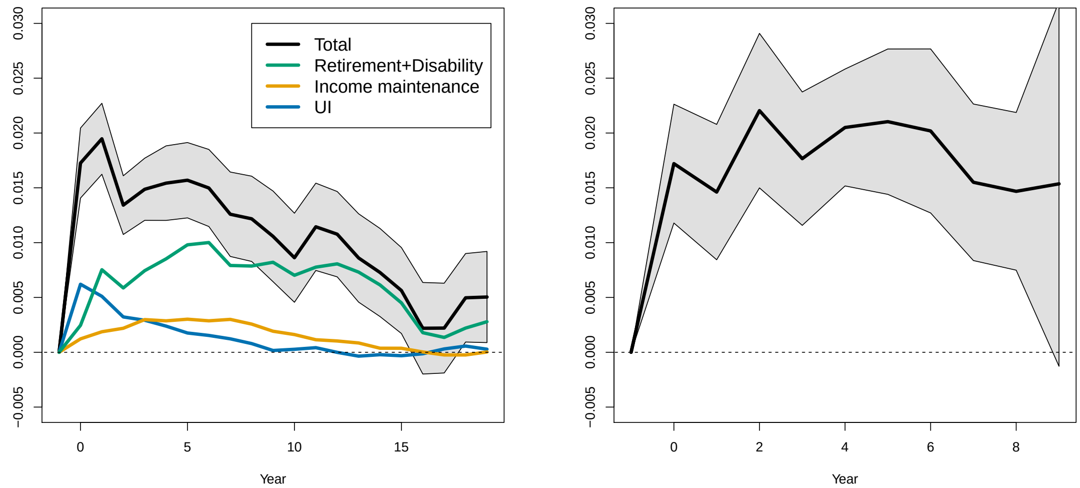


Figure 2: Government transfer impact on log income.

Note: Panel a and b plot local Jorda projections of log public assistance programs and log income retention rates in a commuting zone on innovations in local unemployment, respectively. Results are normalized to correspond to a jump in unemployment of 10 percentage points. Bands indicate 95% confidence intervals clustering on commuting zone.

to the region through various public assistance programs in response to an innovation in local unemployment. I then turn to payments in income tax to see how much less money the government collects from people in the region. Throughout, I will continue to normalize the results to correspond to a 10 percentage point jump in unemployment.

I get information on transfers to each county from the Regional Economic Accounts (REA) managed by the Bureau of Economic Analysis (BEA). They report the aggregate payments to all people in a county for which no service is reported, what they call the personal current transfer receipts. This includes social security benefits, medical benefits, veterans' benefits, and unemployment benefits. It also includes some payments from businesses for things like personal injury, though businesses only make up 1.7% of total current transfers in 2022.

Using τ^c_{nt} to denote personal current transfer receipts per capita, my main specification is:

$$\log \tau^c_{n,t+h} = \beta_h u_{nt} + \gamma^h_n + \gamma^h_{s(n)t} + \sum_{L=1}^{\overline{L}} \gamma^h_{uL} u_{n,t-L} + \gamma^h_O \log \text{OldShare}_{n,t+h} + \varepsilon^c_{nth},$$

where OldShare_{nt} is the share of adults in the commuting zone over 65. Since retirement makes up a large component of the transfers, controlling for the share of people over 65 removes the mechanical increase in τ^c_{nt+h} that would occur as working age people leave the commuting zone to find work elsewhere and retired people stay. I plot the estimates of β_h normalized by the share of income that is personal current transfers to find the log first order impact of the transfer on total log income in the region in Figure 2a. I find that on impact, these transfers spike to increase total take home pay by almost 2%. The size of the transfers then slowly decrease over the next 15 years. In the appendix, I show the results not controlling for the share of people over 65. This has no impact on the results for the first few years, but the transfers do no fall as much. Instead, they stall around 0.01.

The REA then breaks up the personal current transfer receipts into three subcategories: income maintenance benefits; unemployment insurance; and retirement and others. Income maintenance benefits consists of Supplemental Security Income (SSI) benefits, Earned Income Tax Credit (EITC), Additional Child Tax Credit, Supplemental Nutrition Assistance Program (SNAP) benefits, family assistance, and other benefits, including general assistance. These are benefits primarily targeted at supporting people and families that have fallen on hard times. Running the local projection and plotting the results in Figure 2a, normalized by their average share of income, shows that these programs do transfer money to people in the region after a local recession. However, they are quantitatively small. The transfers slowly build for the first 5 years after the shock and then fade out over the next 10 years.

The Unemployment Insurance transfers include the state-administered unemployment programs as well as the special benefits authorized by the federal government for periods of high unemployment. I plot the results of the local projection, normalized by UI's average share of income, in Figure 2a. As expected, unemployment insurance transfers spike exactly when there is an innovation in unemployment. While unemployment transfers themselves see an increase in over 12 log points, because UI is such a small portion of total income, it has a muted effect on total income of the commuting zone. The transfers then slowly fall back towards zero over the next 10 years following the shock.

Finally, the largest component of personal current transfers is the category of retirement and other. This includes retirement and disability insurance payments, medical benefits, veterans' benefits, education and training assistance, as well as other transfers from the government and business. I plot the results of the local projection, again normalized, in Figure 2a. These transfers seem to slowly build over time, and stay high afterwards, consistent with the findings of Autor et al. (2013) that people move into disability after an economic shock. This could be due to changes in composition, but not along age as I continue to control for the old age share.

Finally, I turn to the other side of the government ledger. The Internal Revenue Service (IRS) maintains the Statistics of Income (SOI), and starting in 2010, they record total income tax paid by each county along with total gross income. Thus, I can construct the income retention rate by commuting zone for the years 2010-2021 to see how income tax collection responds to local recessions. I plot the Jorda projection controlling for only one lag of unemployment so that I can get a longer time horizon in Figure 2b. I find that the income retention rate jumps by around 0.015 log points immediately after the shock and remains there for all years that I have data. This is driven primarily by the fact that the United States has a progressive income tax. After the unemployment shock, earnings in the region drop, so that people end up in a lower tax bracket. Therefore, they have to pay a smaller percentage of their income in taxes.

3 A two period model of local recessions

Having demonstrated that local recessions exist, and the US government uses a number of policies to transfer money to regions in response, I now present a simple 2 period model of regional recessions. Wages are perfectly rigid, workers are hand-to-mouth, and goods are either freely traded with no trade costs or non-traded. In this simplified setting, I can fully characterize the solution to a second best planner's problem choosing fiscal transfers to fight local recessions. I can thus illustrate the key economic forces shaping the effectiveness of transfers. Then, in sections 5, 6, and 7, I show how those forces play out in a quantitative dynamic model.

I model all fiscal transfers as explicitly place-based to illustrate the key mechanism in this section, however, as shown above, most transfers to regions in a recession are facially place-neutral. They only end up place-biased because what they target correlates with local recessions. I discuss how this affects my results in section 4.5 and in the quantitative sections.

3.1 Environment

Consider an economy with N regions indexed by $n, m \in \mathcal{N} = \{1, \ldots, N\}$ and two periods indexed by $t \in \{1, 2\}$. Throughout, I will use subscripts to index values and superscripts to index functions. I will then use subscripts on functions to denote partial derivatives.

Households. There is a continuum of households that I index by $\xi \in \Xi$. Denoting location at time t by $n_t^*(\xi)$, each household starts in a location $n_0^*(\xi)$. Then, at the beginning of period $t \in \{1, 2\}$, each household gets preference shocks for every location,

$\boldsymbol{\varepsilon}_t(\xi) = (\varepsilon_{1t}(\xi), \ldots, \varepsilon_{Nt}(\xi)) \in \mathbb{R}^N$ which may depend on household ξ's location at time $t-1$. The utility that household ξ gets from living in location n at time 1 and location m at time 2 is given by

$$U_{nm}(\xi) = U_{n1} + \varepsilon_{n1}(\xi) + \beta\left(U_{m2} + \varepsilon_{m2}(\xi)\right),$$

where U_{nt} is the fundamental utility of location n, and $\beta \in [0,1]$ is the discount rate. $\boldsymbol{\varepsilon}_t$ is distributed according to a continuous cumulative distribution function $G_{n^*_{t-1}(\xi)}(\cdot)$.

Notice that I allow for households to differ in how much they like each of the regions. This could capture moving costs or a taste for region-specific weather. It could also capture the fact that some people are very mobile while others would prefer to stay in their home location no matter how bad it gets.[5]

Then the number of people living in location n at time t, ℓ_{nt}, is given by

$$\ell_{nt} = \overline{\ell} \int_{\Xi} \mathbb{1}_{n^*_t(\boldsymbol{\varepsilon})=n} d\xi,$$

where $\overline{\ell}$ is the total population of the country.

All of the households agree on the fundamental utility of a location. The utility in location n period t is a nested set of functions

$$\begin{aligned} U_{nt} &= U^n(C_{nt}, H_{nt}), \\ C_{nt} &= C^n(C_{Tnt}, C_{NTnt}), \\ C_{Tnt} &= C^T(\{C_{Tmnt}\}), \end{aligned}$$

where C_{nt} is the sub-utility that a household in location n derives from consuming goods, H_{nt} is her per capita hours of labor supply, C_{Tnt} is the consumption of a freely traded aggregate, C_{NTnt} is the consumption of the non-traded good produced in location n, and C_{Tmnt} is the consumption of the traded good produced in location m. I assume that $U^n(C,H)$ is quasi-concave, strictly increasing in C, and decreasing in H. The consumption sub-utility $C^n(C_{Tn}, C_{NTn})$ and $C^T(\{C_{Tmn}\})$ are both homogeneous of degree 1 and quasi-concave.

[5] This general set up nests much of the economic geography literature that puts particular distributional restrictions on $\boldsymbol{\varepsilon}$. The assumption of additive shocks distributed according to a Gumbel distribution as used in Caliendo et al. (2019) is an explicit special case of the model. For the economic geography models that use multiplicative shocks distributed Fréchet as in Fajgelbaum and Gaubert (2020), one can define a new utility as log of the old utility. The set of pareto optimal allocations will be the same in this transformed economy and it will fall under my assumptions. This setup also nests the calvo friction to migration found in Peters (2022) as a limit case.

Firms. In both the freely traded and non-traded sector, a representative firm produces using technology linear in labor. That is,

$$Y_{snt} = A_{sn} H_{snt} \ell_{nt},$$

where Y_{snt} is the production of location n in sector $s \in \{T, NT\}$, A_{sn} is the productivity, and H_{snt} is the per capita labor demand.

Market Clearing. For the labor market to clear in each location, the labor supply needs to equal the labor used by the freely traded sector and the non-traded sector,

$$H_{nt} \ell_{nt} = H_{Tnt} \ell_{nt} + H_{NTnt} \ell_{nt}, \text{ for all } n, t. \tag{1}$$

The market for the non-traded good needs to clear market-by-market,

$$Y_{NTnt} = C_{NTnt} \ell_{nt}, \text{ for all } n, t. \tag{2}$$

And demand for the freely traded good produced in location i needs to equal production,

$$Y_{Tnt} = \sum_m C_{Tmnt} \ell_{nt}, \text{ for all } n, t. \tag{3}$$

Wage Rigidity. Wages in each location W_n are sticky and so are parameters of the model rather than equilibrium objects. The inefficiencies in the model are going to come because wages are either too high or too low given the realized demand for labor in the location embedded in the function $C^T(\cdot)$. When wages are too high, the quantity of labor demanded of households in a location will be below what the household would like to supply. Therefore, those households will be underemployed relative to the first best and policy can play some role in correcting that distortion.[6]

[6] I write the model here as one with wage rigidities that are exogenously set. I could also consider a more standard macro model with monopolistic firms that set prices of goods (or wages) before the realization of some state of the world, but cannot change them in the ex-post stage when the state of the word is realized. At this ex-post stage, prices (or wages) are fixed and the analysis is the same what I undertake here as long as local governments tax away all profits. I will do this in the quantitative section.

3.2 Decentralized equilibrium

Profit maximization. Firms are competitive. They choose production to maximize profits taking as given wages and prices:

$$Y_{snt} \in \underset{Y_s'}{\operatorname{argmax}} \quad \left\{ \left(P_{snt} - \frac{W_n}{A_{sn}} \right) Y_s' \right\}, \text{ for all } s, n, t. \tag{4}$$

Thus, $P_{snt} = W_n/A_{sn}$ for all t and I will drop the t index on prices from now on.

Utility maximization. I will start by taking as given utility in each location and characterize the household's dynamic optimization problem. I will then return to characterize the intratemporal problem.

Households are free to live wherever they would like. Therefore they move to the location that provides them the most utility, however they do not know their utility shocks for period 2 when choosing their first location. Therefore, I characterize the household migration problem using backward induction. In period 2, household ξ observes her utility shocks $\boldsymbol{\varepsilon}_2$ and chooses

$$n_2^*(\xi) \in \underset{n'}{\operatorname{argmax}} \quad U_{n'2} + \varepsilon_{n'2}(\xi). \tag{5}$$

Denote by $\overline{U}_{n2} \equiv \mathbb{E}[\max_{n'} U_{n'2} + \varepsilon_{n'2} | n_1^*(\xi) = n]$ the expected utility in period 2 of a household who lives in location n at the end of period 1, before the idiosyncratic utility shocks $\boldsymbol{\varepsilon}_2$ are revealed. Then in period 1, the household chooses her location to maximize expected utility,

$$n_1^*(\xi) \in \underset{n'}{\operatorname{argmax}} \quad U_{n'1} + \beta \overline{U}_{n'2} + \varepsilon_{n'1}(\xi). \tag{6}$$

Conditional on living in location n at time t, households choose consumption to maximize utility subject to a single period budget constraint as they cannot save,

$$\sum_m P_{Tm} C_{Tmnt} + P_{NTn} C_{NTn} \leqslant W_n H_{nt} + T_{nt},$$

where P_{Tm} is the price of the freely traded good produced in location n, P_{NTn} is the price of the non-traded good produced in location n, W_n is the wage paid in location n, and T_{nt}

is the per capita transfer from the government to people in location n at time t. That is

$$\{C_{nt}, C_{NTnt}, C_{Tnt}, \{C_{Tmnt}\}\} \in \underset{C, C_{NT}, C_T, \{C_{Tm}\}}{\operatorname{argmax}} \Bigg\{ U^n(C, H_{nt}) \Bigg| \begin{aligned} & C = C^n(C_T, C_{NT}), \\ & C_T = C^T(\{C_{Tm}\}) \\ & \sum_m P_{Tm} C_{Tm} + P_{NTn} C_{NT} \leqslant W_n H_{nt} + T_{nt} \end{aligned} \Bigg\}. \tag{7}$$

The nested nature of the preferences allows for the problem to be broken down into sub-components. First note that $C_T(\cdot)$ is homogeneous of degree 1 and identical across locations. Then since there are no trade costs within the traded sector, there exists a common aggregate price of the traded good $P_T = \min\{\sum_m P_{Tm} C_{Tm} | C^T(\{C_{Tm}\} \geqslant 1\}$. In turn, the price of the consumption aggregate C_{nt} in each location n is $P_n = \min\{P_{NTn} C_{NT} + P_T C_T | U^n(C_{NT}, C_T) \geqslant 1\}$.

Importantly, households do not choose their hours H_{nt}. Instead, labor is completely demand determined in each location. This creates a wedge since the marginal rate of substitution between consumption and labor may not be equal to the relative price. With flexible wages, the household would choose consumption and labor supply so that $U^n_C / P_n = -U^n_H / W_n$. The labor wedge is a measure of how far this first order condition is from being satisfied. I will denote it

$$\tau_{nt} \equiv 1 + \frac{P_n}{W_n} \frac{U^n_H}{U^n_C}.$$

If an economy is in a boom, then the house is working more than it would like. Therefore, $|U^n_H|$ will be high, leading to a negative labor wedge. The wedge will be positive if the region is going through a local recession.

Government policy. The government serves two roles. The first role it plays is in transferring money between regions. The budget constraint[7] at period t for the national government is

$$\sum_n \ell_{nt} T_{nt} = 0. \tag{8}$$

The second role the government plays is determining aggregate demand through monetary policy. In this simplified setup, I assume that the government can choose nominal GDP

[7] I assume that the government needs to run a balanced budget in each period for simplicity. None of the results below depend on it.

directly

$$E_t = \sum_n P_n C_{nt} \ell_{nt}. \tag{9}$$

In a richer, dynamic model, the government would do this by setting the interest rate.

Definition 1. *Given nominal GDP in each period E_t and per capita transfers T_{nt}, an* equilibrium *is a set of location choices $n_t^*(\xi)$, utility levels $U_{nm}(\xi)$, U_{nt}, regional population ℓ_{nt}, prices for freely trade goods P_{Tn}, prices for non-traded goods P_{NTn}, consumption levels C_{Tmnt}, C_{NTnt}, labor supplies H_{nt}, and output Y_{NTnt}, Y_{Tnt}, such that:*

- *Households choose consumption and their location to maximize utility,* (5)*,* (6)*,* (7)*;*
- *Firms maximize profits taking prices as given,* (4)*;*
- *The government's budget constraints hold,* (8)*;*
- *The total value of consumption is equal to nominal GDP* (9)*; and*
- *Markets clear,* (1)*,* (2)*,* (3)*.*

3.3 The planner's problem

The planner chooses monetary policy E_t, place-based transfers T_{nt}, and associated expected utilities $U(\xi) \equiv \max_n U_{n1} + \varepsilon_{n1}(\xi) + \beta \overline{U}_{n2}$ to maximize social welfare. I assume that social welfare is a weighted sum of utility with weight $\lambda(\xi)$ on household ξ. Formally, the planner faces the problem

$$\max_{E_t, \{T_{nt}\}, \{U(\xi)\} \in \mathcal{E}} \int_{\Xi} \lambda(\xi) U(\xi) d\xi, \tag{10}$$

were $\mathcal{E}$ is the set of utility profiles attainable in a competitive equilibrium, as described in Definition 1.

4 Optimal place-based transfers

In this section, I derive the implications for optimal regional transfers in the aftermath of a recession. Before I do that, I characterize the economy of a location n at time t as a function of monetary policy, the population ℓ_{nt}, and the transfer from the government T_{nt}. This will provide some intuition for how national fiscal and monetary policy can affect regions in a recession, and also simplify the planner's problem. In setting this up, it will be easier to think of monetary policy as choosing the national spending on the traded sector, E_{Tt} where $E_{Tt} \equiv \sum_m P_T C_{Tmt} \ell_{mt}$, rather than total spending. I show these are equivalent, and provide all of the proofs for this section, in appendix B.

4.1 Characterizing local equilibria

The derivation of the local equilibrium proceeds in two steps. I start by characterizing the consumption decision of households in each location. I then find what labor supply is consistent with those consumption choices and government policy.

Since prices are fixed and the consumption aggregator over the traded output of each location is homothetic, households spend a fixed proportion ϕ_m of their traded expenditures on the output of location j, i.e.

$$P_{Tm}C_{Tmnt} = \phi_m P_T C_{Tnt}.$$

Multiplying by the population in location n, ℓ_{nt}, and summing across all locations we get that total spending on the traded output of location m is a fixed share of traded output,

$$P_{Tm}Y_{mt} = \phi_m E_{Tt}.$$

Total labor earnings in location m, $W_j H_{mt}\ell_{mt}$, is then that spending on traded output plus spending on the non-traded good. Spending on the non-traded good is simply a fixed share of total income α_m, and total income is labor earnings $W_m H_{mt}\ell_{mt}$, plus the transfer from the government $T_{mt}\ell_{mt}$, i.e.

$$W_m H_{mt}\ell_{mt} = \phi_m E_{Tt} + \alpha_m \left(W_m H_{mt}\ell_{mt} + T_{mt}\ell_{mt}\right).$$

This defines hours worked as a function of monetary policy E_{Tt}, population ℓ_{mt}, and the transfer from the government T_{mt}. I formally define this function,

$$H^m(E_T, \ell, T) \equiv \frac{1}{W_m}\left(\frac{\phi_m E_T}{1-\alpha_m}\frac{1}{\ell} + \frac{\alpha_m}{1-\alpha_m}T\right). \tag{11}$$

To complete the description of the local equilibrium, I also define an indirect utility function for households in location m only as a function of the transfer T_m and hours worked H_m. Plugging in that real consumption is total earnings $W_m H$ plus the transfer T divided by the price level P_m, I get that

$$V^m(T, H) \equiv U^m\left(\frac{W_m}{P_m}H + \frac{T}{P_m}, H\right). \tag{12}$$

Understanding the derivatives of these functions is crucial for building intuition.

Lemma 1. *The derivatives of the indirect utility function are*

$$\begin{aligned} \frac{\partial V^n}{\partial T} &= \frac{U_C^n}{P_n}, \\ \frac{\partial V^n}{\partial H} &= W_n \frac{U_C^n}{P_n} \tau_{nt}. \end{aligned} \tag{13}$$

The derivatives of the hours worked function are

$$\begin{aligned} \frac{\partial H^n}{\partial T} &= \frac{1}{W_n} \frac{\alpha_n}{1-\alpha_n}, \\ \frac{\partial H^n}{\partial \log E_T} &= \frac{1}{W_n} \frac{\phi_n E_T}{1-\alpha_n} \frac{1}{\ell}, \\ \frac{\partial H^n}{\partial \log \ell} &= -\frac{1}{W_n} \frac{\phi_n E_T}{1-\alpha_n} \frac{1}{\ell}. \end{aligned} \tag{14}$$

I start by considering how E_T shapes the local equilibrium through equation (14). When the central government heats up the entire economy by increasing spending in the freely traded sector, the people in each location will work more in the freely traded sector. However, at the same time, they will get more money, and they will want to spend that money on traded and non-traded goods. This will increase demand for the local non-traded good, increasing the labor supplied to that sector leading to a feedback loop. The size of that feedback loop is summarized by the proportion of spending on the non-traded good, α_n. What this means for the utility of households in region n depends on if the location were in a boom or bust. If it was in a bust ($\tau_{nt} > 0$), then the households there like the opportunity to work more and earn more money as shown in (13). If the labor market was already hot, people will not like working even harder.

In this model, migration ends up having a similar effect on utility as increasing the level of expenditures on freely traded goods as seen in equation (14). Suppose that more people move to location n. The demand for the traded output of the location remains the same which means they cannot start producing more. Instead, everyone needs to reduce the number of hours they are working so that the total number of hours worked remains the same when you include the extra people. Then the feedback loop I mentioned above happens again leading to reduced hours per person in the non-traded sector as well. The effect on utility then depends on the labor wedge of (13). If the area is in a recession, people leaving will increase the utility of those left behind because it opens up more working opportunities.

Direct monetary transfers from the government behave very differently. In particular, they provide a direct utility benefit by increasing consumption of the traded goods (13) on top of the stimulus effect (14). Whether people appreciate working more depends again on the state of the economy. If the economy is in a recession ($\tau_n > 0$), then $V_T^n + V_H^n H_T^n > \frac{U_C^n}{P_n}$, and there are positive externalities from spending more. If the economy is already booming then working more will hurt the residents and the total benefit from a transfer is smaller than the private internalized benefit.

4.2 The relaxed planner's problem

Having characterized the local equilibrium, we can now restate the planner's problem in a simplified form. Taking as given where everyone starts, the population of location n in period 1 will be a function of the fundamental expected utility households can expect from living in each location m,

$$\ell_{n1} = \ell^{n1}\left(\{U_{m1} + \beta \overline{U}_{m2}\}\right) \text{ for all } n. \tag{15}$$

Conditional on being in location n at the end of period 1, location in period 2 depends only on period 2 utility. Thus we can define a function $\mu^{nm}(\{U_{k2}\})$ as the share of households who move from location n to location m as a function of fundamental utility. Then population in period 2 is

$$\ell_{m2} = \sum_n \ell_{n1} \mu^{nm}(\{U_{k2}\}) \text{ for all } m. \tag{16}$$

As I showed in the previous subsection, in any equilibrium, utility needs to be equal to the indirect utility functions,

$$U_{mt} = V^j\left(T_{mt}, H^m\left(E_{Tt}, \ell_{mt}, T_{mt},\right)\right) \text{ for all } m. \tag{17}$$

Then the original maximization problem is equivalent to the relaxed problem,

$$\max_{E_t, \{T_{nt}\}, \{U_{nt}\}, \{\ell_{nt}\}} \int_{\Xi} \lambda(\xi) \sum_n \mathbb{1}_{n \in \arg\max U_{n'1} + \varepsilon_{n'1}(\xi) + \beta \overline{U}_{n'2}} \left[U_{n1} + \varepsilon_{n1}(\xi) + \beta \overline{U}_{n2}\right] d\xi, \tag{18}$$

subject to the free mobility constraints, (15), (16), the utility constraints, (17), and the budget balance constraints, (8).

Throughout, I will focus on transfers in the limit as $\beta \to 0$. This will allow me to focus on the static implications for policy in the first period without worrying about the second period. Then in the second period, I can illustrate the dynamic implications of policy while ignoring the feedback effects of the first period back on the second period.

4.3 Implications for place-based transfers in period 1

I start by asking how a small transfer in period 1 to a small location like Janesville will affect social welfare. Assume that there are two locations, one small region j (Janesville) that is in a recession ($\tau_{jt} > 0$) and a much larger location u that is not (rest of the United States) because monetary policy adjusts to set the labor wedge to 0.

Suppose that, starting from an equilibrium with no transfers, the national government gives a small transfer to Janesville, $dT_{j1} > 0$, paid for with a small tax on the rest of the US, $dT_{u1} = -\frac{\ell_{j1}}{\ell_{u1}} dT_{j1}$. Then, as in lemma 1, the utility effect of those transfers in each location is given by the direct change in consumption along with the effect on labor demand. In particular,

$$dU_{n1} = \frac{U_C^n}{P_n} dT_{n1} + W_{n1} \frac{U_C^n}{P_n} \tau_{n1} dH_{n1}.$$

Therefore, when the national government has no redistributive motive, i.e. the value to the planner of another dollar of consumption is the same in both locations $\overline{\lambda}_{jt} U_C^j / P_j = \overline{\lambda}_{ut} U_C^u / P_u$ where $\overline{\lambda}_{nt}$ is the average pareto weight on people in location n, the effect on total social welfare is

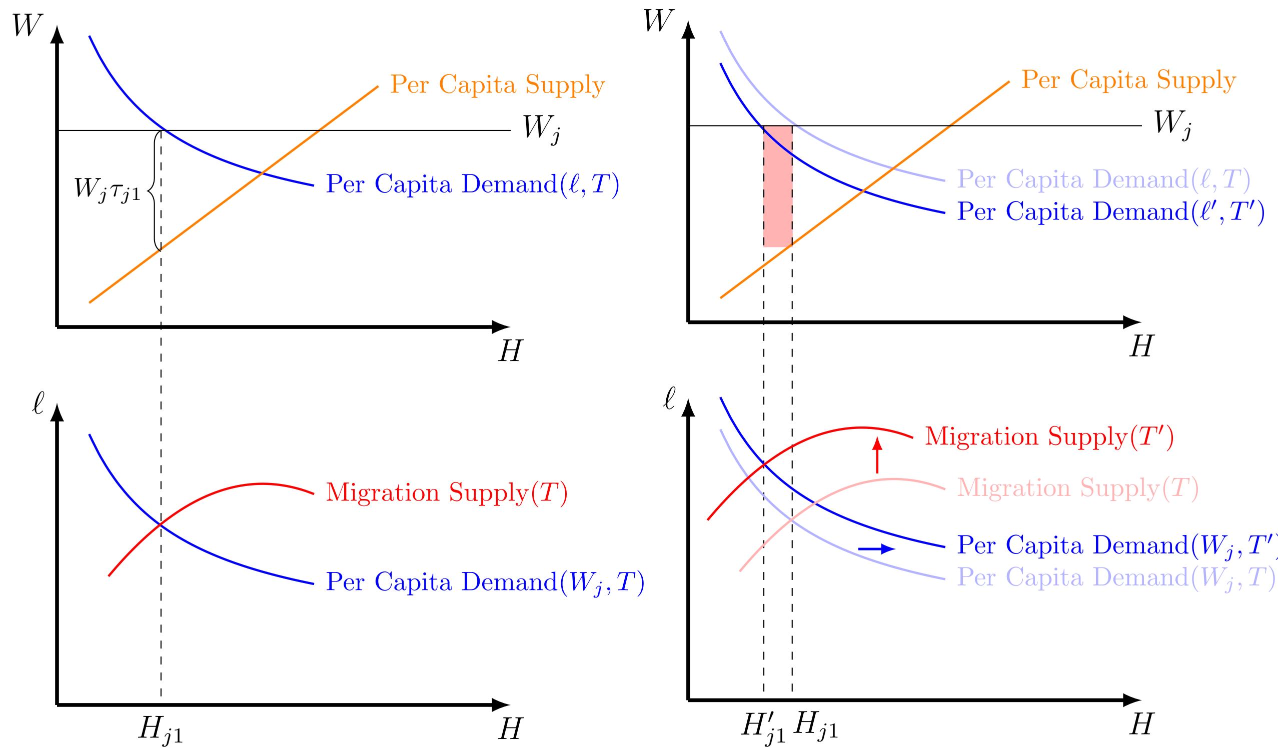
$$\begin{aligned}
d\mathcal{W} &= \overline{\lambda}_{j1} \ell_{j1} dU_{j1} + \overline{\lambda}_{u1} \ell_{u1} dU_{u1} \\
&= \overline{\lambda}_{j1} \ell_{j1} \left(\frac{U_C^j}{P_j} dT_{j1} + W_j \frac{U_C^j}{P_j} \tau_{j1} dH_{j1} \right) + \overline{\lambda}_{u1} \ell_{u1} \frac{U_C^u}{P_u} dT_{u1} \\
&= \ell_{j1} dT_{j1} + \ell_{j1} W_j \tau_{j1} dH_{j1} - \ell_{u1} \frac{\ell_{j1}}{\ell_{u1}} dT_{j1} \\
&= \ell_{j1} W_j \tau_{j1} dH_{j1}.
\end{aligned}$$

That is, a transfer to Janesville increases social welfare if and only if it increases the per capita labor demand.

I graph the equilibrium in Figure 3a in order to illustrate the comparative static. The top panel plots the usual per capita labor demand and per capita supply, holding fixed the transfer from the government and total population. Distinct from the usual supply and demand framework, wages are rigid at W_j and so do not clear the market. $W_j \tau_{j1}$ then measures how far off households in location j are from their ideal labor supply.

To complete the description of equilibrium, I endogenize ℓ_{j1} in the bottom panel of Figure 3a. I start by plotting the migration supply curve in red. This curve shows how many households would like to live in location j as a function of the employment rate. It is increasing for most H_{j1} because the region is in a recession and utility increases in

Figure 3: Illustration of stimulus and migration effect of a transfer



(a) No policy

(b) Positive transfer

the employment rate. Then I also plot the per capita demand for labor as a function of population, taking as given the fixed wages. Where they cross determines the equilibrium population and employment rate. Then we return to the top panel to find the associated labor wedge.

I plot how the equilibrium changes when the national government gives a small transfer in Figure 3b. Just looking at the top panel, it is not clear if per capita labor demand will increase or decrease after the transfer. As I discussed when explaining lemma 1, the transfer will have a direct effect to increase labor demand through the stimulus effect. However, it will also influence how many people would like to live in the location, and increases in population decrease per capita demand.

Thus, we need to look at the lower panel of Figure 3b. First, the transfer shifts out the per capita demand curve. For any given amount of population, if those households have extra income, there will be more demand for their labor because there is home bias in consumption. If this were the only direct effect of a transfer, then the transfer might affect total population, but the inflow of population could not decrease per capita labor supply. The migration effect could only mitigate the effects of fiscal transfers through a shift along the migration supply curve.

However, that is not the case here because transfers directly increase utility independent of the stimulus effect. Therefore, the migration supply curve also shifts up. And if people are sufficiently mobile, the migration effect can dominate, leading to a decrease in per capita labor after the transfer to Janesville. That is the case I have drawn in Figure 3b. Social welfare ends up decreasing by the population of Janesville multiplied by the area of the shaded rectangle.

What determines how much the migration supply curve and the per capita demand curve shift? Notice that locally, population changes according to

$$\begin{aligned} d\log \ell_{j1} &= \frac{\partial \log \ell^{j1}}{\partial U_{j1}} dU_{j1} \\ &= \frac{\partial \log \ell^{j1}}{\partial U_{j1}} \left(\frac{U_C^{j1}}{P_j} dT_{j1} + W_j \frac{U_C^j}{P_j} \tau_{j1} dH_{j1} \right). \end{aligned}$$

That is, locally the migration supply curve shifts up by $\frac{\partial \log \ell^{j1}}{\partial U_{j1}} \frac{U_C^{j1}}{P_j} dT_{j1}$. Meanwhile, totally differentiating the expression for hours of employment shows that per capita demand shifts

$$W_j dH_{j1} = -\frac{\phi_j E_{Tt}/\ell}{1-\alpha_j} d\log \ell_{j1} + \frac{\alpha_j}{1-\alpha_j} dT_{j1}.$$

Rearranging so that $d\log \ell_{j1}$ is on the left hand side, we get that, per capita demand shifts up by $\frac{1}{\frac{\phi_j E_{Tt}/\ell}{1-\alpha_j}} \frac{\alpha_j}{1-\alpha_j}$. Then giving a transfer to Janesville improves welfare if and only if the per capita demand curve shifts more than the migration supply curve, i.e.

$$\frac{\alpha_j}{1-\alpha_j} > \frac{W_j H_{Tj1}}{1-\alpha_j} \frac{\partial \log \ell_{j1}}{\partial T_{j1}},$$

where $\frac{\partial \log \ell^{j1}}{\partial T_{j1}} \equiv \frac{\partial \log \ell^{j1}}{\partial U_{j1}} \frac{\partial V^j}{\partial T}$ is the semi-elasticity of population to a transfer, holding fixed labor, and $W_j H_{Tj1} = \phi_j E_{Tt}/\ell$ is per capita earnings from the traded sector. But we can simplify this at the point $T_{j1} = 0$ since $W_j H_{Tj1}$ is $1-\alpha_j$ share of total income, $W_j H_{j1}$. The right hand side can be rewritten as wage elasticity holding fixed hours worked. Thus, a transfer to Janesville improves welfare if and only if the local multiplier is larger than the elasticity of population to wages,

$$\frac{\alpha_j}{1-\alpha_j} > \frac{\delta \log \ell_{j1}}{\delta \log W_j}\Big|_{\delta H_{j1}=0}. \tag{19}$$

While this is useful for demonstrating the key effects, it does not tell us what the optimal policy is. To do that, I return to the planner's problem (18) and take the first order conditions. I start by summarizing how monetary policy adjusts in the background to ensure that the average labor wedge across locations is zero.

Lemma 2. *In any interior equilibrium,*

$$\sum_n \frac{W_n H_{Tn1}}{1-\alpha_n} \ell_{n1} \frac{\tau_{n1}}{1+\frac{\alpha_n}{1-\alpha_n}\tau_{n1}} = 0.$$

Then the fiscal transfers can work to fight idiosyncratic regional recessions that cannot be addressed by national monetary policy. The first order condition for a transfer to location n implies the next lemma.

Lemma 3. *In any interior equilibrium, first period transfers must satisfy*

$$\underbrace{\sum_m \ell_{m1} T_{m1} \nu_{n1}^m}_{\textit{fiscal externality}} = \ell_{n1} \Bigg[\underbrace{\frac{\overline{\lambda}_{n1} U_C^n}{\lambda_1^T P_n}}_{\textit{redistribution}} \underbrace{\left(1 + \frac{\alpha_n}{1-\alpha_n}\tau_{n1}\right)}_{\textit{stimulus effect}} - 1 \Bigg] - \underbrace{\sum_m \frac{W_m H_{Tm1}}{1-\alpha_m} \ell_{m1} \frac{\tau_{m1}}{1+\frac{\alpha_m}{1-\alpha_m}\tau_{m1}} \nu_{n1}^m}_{\textit{migration effect}},$$

where $\nu_{n1}^m \equiv \frac{\partial \log \ell^{m1}}{\partial U_{n1}} \left(\frac{\partial V^n}{\partial T_{n1}} + \frac{\partial V^n}{\partial H_{n1}} \frac{\partial H^{n1}}{\partial T_{n1}} \right)$ *is the migration semi-elasticity of population in location* m *to a transfer in location* n *holding fixed utility in locations other than* n, $\overline{\lambda}_{n1} = \mathbb{E}[\lambda(\xi) | n_1^*(\xi) = n]$ *is the average pareto weight on households in location* n, *and* $\lambda_1^T > 0$ *is the Lagrange multiplier on the government budget constraint in period 1.*

Increasing the transfer to location n has four effects, labeled in lemma 3. The first effect is a fiscal externality. By increasing the transfer to location n, households will move away from other locations and into location n. The extent to which the planner appreciates this movement depends on how much people were being taxed in their old location versus their tax in their new location. If households were being taxed in their previous location m but gaining a transfer in their new location n, this will hurt the government's ability to raise money.

The next effect is a direct redistributive effect. Ignoring any effect on labor demand, giving a transfer to people in location n increases utility. The amount depends on n's marginal utility of consumption U_C^n, and the price index P_n. Finally, how much the planner values that over other uses of the money is simply the average pareto weight on households in that location divided by the marginal value of a dollar for the government $\overline{\lambda}_{n1}/\lambda_1^T$.

The final two effects are the macroeconomic effects that are the focus of this paper. First, we have the stimulus effect. When the government increases transfers to a location n, utility increases over and above the direct utility benefit when n is in a recession because labor demanded increases by a factor of $\frac{\alpha_n}{1-\alpha_n}$ as discussed in lemma 1. Second, we have the migration effect. Providing a transfer to location n will increase the population in location n and decrease the population in every other location m. If the regions households leave are in a recession, the out migration is good, while if those regions are in a boom, that will be harmful as discussed in lemma 1. The total migration effect of a transfer then depends on the distribution of recessions τ_{m1} and the matrix of migration semi-elasticities ν_{n1}^{m}.

Specializing these equations to the Janesville case I laid out above, I find the following.

Proposition 1. *Suppose that there are two locations, j (Janesville) and u (Rest of the US), location j is arbitrarily small compared to location u, $\ell_{jt}/\ell_{ut} \to 0$, and there are no redistributive reasons for policy, $\overline{\lambda}_{nt} U_C^n / P_n = 1$. Then in any interior equilibrium, the optimal period 1 transfer to location j must satisfy*

$$T_{j1} = \frac{1}{\nu_{j1}^{j}} \left(\frac{\alpha_j}{1-\alpha_j} - \frac{W_j H_{Tj1}}{1-\alpha_j} \frac{\partial \log \ell^{j1}}{\partial T_{j1}} \right) \tau_{j1},$$

where $\frac{\partial \log \ell^{j1}}{\partial T_{j1}} \equiv \frac{\partial \log \ell^{j1}}{\partial U_{j1}} \frac{\partial V^j}{\partial T}$ is the semi-elasticity of location 1 population to a transfer, holding fixed labor supply, and $\nu_{j1}^{j} \equiv \frac{\partial \log \ell^{j1}}{\partial U_{j1}} \left(\frac{\partial V^j}{\partial T_{j1}} + \frac{\partial V^j}{\partial H_{j1}} \frac{\partial H^{j1}}{\partial T_{j1}} \right)$ is the semi-elasticity of location 1 population to a transfer, allowing labor supply to vary.

Proposition 1 makes clear that the basic intuition of equation (19) carries over to the fully optimal policy. Whether a transfer to a region in a recession should be positive or negative depends on two statistics: the local spending multiplier $\frac{\alpha_j}{1-\alpha_j}$, and the migration semi-elasticity holding fixed employment $\frac{\partial \log \ell_{j1}}{\partial T_{j1}}$. While a transfer might have a direct stimulus effect, when households are sufficiently mobile, a transfer could actually be counterproductive because it encourages too many workers to remain in the recessionary region. The size of the transfer is then adjusted by the migration semi-elasticity that includes the change in employment, ν_{j1}^{j}, since that summarizes the strength of the fiscal externality.

Thus, in general, transfers are poorly targeted to fight local recessions because they directly impact both the demand and supply in a local region. While Mundell (1961) might have been right that factor mobility can help a currency union operate in the absence of fiscal transfers, factor mobility also makes fiscal transfers less effective at fighting local recessions. If labor is sufficiently mobile, Kenen (1969)'s insight that the government would want to transfer money to regions in a recession can actually be overturned.

In practice, many labor demand shocks do not hit only one small region. Instead, they hit whole industries, as is the case with the China trade shock. In that case, the migration effect of a transfer can have more complicated effects. If giving a transfer to a region in a recession causes households to leave a town that is in a worse recession, the migration effect will be a net positive. The next proposition makes precise how the spatial distribution of shocks interacts with migration patterns to shape optimal spatial policy.

Proposition 2. *Suppose that there are two large locations, s (southern US) and n (northern US), and location n is in a recession while location s is in a boom. Further suppose that there is a small location j (Janesville). Then when there are no insurance reasons for transfers,*

$$T_{j1} > \frac{1}{\nu_{j1}^{j}} \left(\left[\frac{1}{\lambda_1^T} - 1 \right] + \frac{1}{\lambda_1^T} \frac{\alpha_j}{1-\alpha_j} - \frac{W_j H_{Tj1}}{1-\alpha_j} \frac{\partial \log \ell^{j1}}{\partial T_{j1}} \right) \tau_{j1},$$

if and only if migrants to j disproportionately come from n, i.e. $|\nu_{j1}^{n}|/|\nu_{j1}^{s}| > \ell_{n1}/\ell_{s1}$.

Proposition 2 says that if migrants to location j disproportionately come from the Northern part of the US, which is in a recession, the national government should give more money to location j than that suggested by the local fiscal multiplier and migration semi-elasticity. That is because the transfer encourages more people to leave another region in a recession, increasing per capita employment there, and thereby increasing total welfare. The formula is slightly more complicated than that in Proposition 1 because with two locations, the Lagrange multiplier on the budget constraint λ_1^T is no longer equal to 1. Therefore, the stimulus effect needs to be balanced against other uses of the money.

This implies that the nature of the demand shock matters for the optimal policy. If the shock is very correlated, then regions that are in recessions will be near other regions in recessions. Therefore, a transfer to one of those regions will not have a large net migration effect since all migrants in response to the transfer will come from other areas also in a recession. Thus, the China trade shock might call for more aggressive transfers from the national government than an idiosyncratic shock like the closure of the Janesville Assembly Plant. I will return to this quantitatively in section 7.

4.4 Implications for place-based transfers in period 2

Having shown that fiscal transfers to a region in the immediate aftermath of a factory closure have competing stimulus and migration effects, I next turn to the effects of a transfer in the long run. One might think that the same basic trade-off between the migration effect and the stimulus effect apply in the second period as it did in period 1. The only difference is that people have more time to move so that the migration effect will likely be stronger. That is wrong.

To demonstrate why, I start by stating the first order necessary condition for a transfer to location n in period 2.

Lemma 4. *Take the limit as $\beta \to 0$. Then in any interior equilibrium, second period transfers must satisfy*

$$\sum_t \frac{\lambda_t^T}{\lambda_2^T} \sum_m \ell_{mt} T_{mt} \nu_{n2}^{mt} = \ell_{n2} \left[\frac{\beta \overline{\lambda}_{n2} U_C^n}{\lambda_2^T P_n} \left(1 + \frac{\alpha_n}{1-\alpha_n} \tau_{n2} \right) - 1 \right] - \sum_t \frac{\lambda_t^T}{\lambda_2^T} \sum_m \frac{W_m H_{Tmt}}{1-\alpha_m} \ell_{mt} \frac{\tau_{mt}}{1 + \frac{\alpha_m}{1-\alpha_m} \tau_{mt}} \nu_{n2}^{mt},$$

where λ_2^T is the Lagrange multiplier on the government's budget constraint in period 2, and ν_{n2}^{mt} is the elasticity of population in location m at time t to a transfer to location i at time 2.

Lemma 4 shows the same four effects of a transfer from the period 1 first order condition: fiscal externality, redistribution, stimulus, and migration. The redistribution and stimulus effects remain the same as before. Transferring money to people in location n will increase utility through increasing income U_C^n/P_n. And how much that means to the planner is the discounted pareto weight the planner puts on people in location n divided by the lagrange multiplier on the budget constraint in the second period $\beta\overline{\lambda}_{n2}/\lambda_2^T$. Similarly, the transfer leads to a stimulus of $\frac{\alpha_n}{1-\alpha_n}$. The only difference is that real consumption and the labor wedge might be different at time 2 than time 1.

Both the fiscal externality and the migration effect now have dynamic components. That is because, a promise to tax certain locations at time 2 will affect where households decide to live at time 1. Therefore, the planner has to take into account how that movement in the first period will affect the fiscal externality and recessions in the first period. Since I took the limit as $\beta \to 0$, the actual effect is very small. However, the planner has a very small lagrange multiplier on the budget constraint in period 2, so the effect still shapes the optimal policy.

In the next proposition, I consider what this implies for optimal policy in Janesville in period 2.

Proposition 3. *Suppose that there are two locations, j (Janesville) and u (Rest of the US), location j is arbitrarily small compared to location u, $\ell_{jt}/\ell_{ut} \to 0$, there are no redistributive reasons for policy, $\overline{\lambda}_{it} U_C^i / P_i = 1$, j is in a recession, $\tau_{jt} > 0$, and agents are impatient, $\beta \to 0$. Then in any interior equilibrium, the optimal period 2 transfer to location j satisfies*

$$T_{j2} < \frac{1}{\nu_{j2}^{j2}} \left(\frac{\alpha_j}{1-\alpha_j} - \frac{W_j N_{Tj2}}{1-\alpha_j} \frac{\partial \log \ell^{j2}}{\partial T_{j2}} \right) \tau_{j2},$$

when the share of workers in location j in period 1 who stay in location j in period 2 is greater than zero.

Comparing Proposition 3 to Proposition 1 reveals that in period 2, the transfer to a region in a recession is always smaller than the transfer implied by the simple static trade-off between the stimulus effect and the migration effect.

A transfer in the second period has the same stimulus, migration, and fiscal externality effects on period 2 as first period transfers did in period 1. However, giving a transfer to people in Janesville in period 2 also increases the expected utility of living in Janesville in period 1 if there are some moving costs. Therefore, if the planner promises to give a transfer to people who are in Janesville in period 2, people who would have left in period 1 because they had a job opportunity somewhere else will be less likely to leave. So the period 2 transfer will increase population in period 1 Janesville, impacting the first period fiscal externality and migration effect.

What is the net effect on social welfare? To answer that, we need to know the signs and relative strength of those two forces. The key is to note that period 1 transfers already reveal something about their combined effect. Period 1 transfers optimally trade off those exact forces that come from an increase in population against the positive stimulus effect of giving a little extra money to people in location 1. Therefore, the net effect of increasing population in period 1 Janesville must be negative, and a transfer in period 2 makes that worse. Therefore, transfers in period 2 should be smaller than what would be suggested by the static trade-off since taxes in period 2 allow the planner to encourage out migration without decreasing stimulus in the first period.

Other things being equal, the optimal transfer to a region in a recession should be front loaded. I will demonstrate how this plays out quantitatively in sections 6 and 7.

4.5 Extensions and robustness

The model so far has been stylized to shed light on the key forces shaping optimal fiscal policy in the most transparent way possible. Here I consider how the results change when I include other real world features.

Downward wage rigidity and costly price adjustments. This model features perfect wage rigidity, but empirical evidence suggests that wages are more rigid going downwards. In appendix C.1, I consider a variant of this model with 2 locations, downward wage rigidity, and costly upward price adjustments. In that case, Propositions 1 and 3 remain exactly the same.

Place-biased policy. As I have shown, the United States does not use explicitly place-based transfers. Instead, the many tax and spending programs work as automatic stabilizers to transfer money towards regions in a recession because unemployment spikes and incomes decrease after a bad shock. These place-biased transfers will clearly have the same stimulus effects I emphasized here. However, they also have the migration effect. Because the tax rate is progressive, higher paying jobs are less attractive. Therefore, households have less incentive to take a higher paying job in a region with higher demand. Similarly, unemployment benefits reduce the incentive to find a job. Assuming that it is easier to find a job in a low unemployment area, this reduces the attractiveness of other regions not in a recession. In appendix C.2, I show how these policies work in the model extension with downward wage rigidity. I also shed light on how effective these policies are in the quantitative section 6.

Households affect demand. In appendix C.3, I consider an extension of the model to have multiple household types θ who can affect demand for a particular region. These could represent entrepreneurs, for example. When they move into a region, they open up new businesses that export new products to the rest of the country. I show that the migration effect then also has an effect on demand that depends on the covariance between the household type's effect on demand and their migration semi-elasticity to the transfer. In practice, this covariance is likely small since entrepreneurs likely move to areas with good economic conditions, regardless of the government transfers, though this force could suggest other place-based policies to fight local recessions.

Wage stickiness only in traded goods. While Autor et al. (2013) found that earnings decreased significantly, they found no evidence that wages decreased in the manufacturing sector. Instead, all of the wage movement was in services. In appendix C.4, I consider an extension of the model where labor is imperfectly substitutable across the traded and non-traded sector, and wages are not sticky in the non-traded sector. In that case, there is no stimulus effect of a transfer because there is no wedge on the non-traded labor. Instead, there is only a migration effect, so the optimal transfer is always negative.

Monetary policy. I also consider the implications for monetary policy in Appendix B.1. I show that in the baseline model, there is a contractionary bias to monetary policy. By under heating the economy, the regions in a recession become less attractive since unemployment is higher. Conversely, regions that are booming become more attractive because they are not working too much. Thus, households are encouraged to move out of recessionary regions into regions doing well.[8]

[8] This force is closely related to the contractionary bias in times of industrial reallocation of Guerrieri et al. (2021) when wages are perfectly sticky and workers can reallocate across sectors.

5 Dynamic New Keynesian economic geography model

The two period model with freely traded and non-traded goods in section 3 reveals the key forces in a transparent manner, but it is too stylized to bring to the data to find how large place-based transfers should be. In particular, it does not allow us to think about how finite trade costs and imperfect wage rigidity affect the size and timing of optimal transfers.

In this section, I present a continuous time model of New Keynesian economic geography with structural assumptions that will allow me to map to the data in a transparent way. While the structure limits the model compared to that in section 3, it also allows me to include finite trade costs and slowly adjusting wages so that I can match key moments in the real world. I then discuss how I operationalize the model by approximating the solution and calibrating it to the 722 commuting zones in the contiguous United States. The quantitative implications are presented in sections 6 and 7.

5.1 Environment

There are N regions indexed by $n, m \in \mathcal{N} = \{1, \ldots, N\}$, one non-traded sector and one traded sector, and continuous time indexed by $t \in [0, \infty)$.

In every period, households consume a consumption aggregate and elastically supply labor to the local industries. The opportunity to migrate subject to moving costs arrives at an exogenous poisson rate. The consumption aggregate is a cobb-douglas aggregation of sectoral goods that themselves are armington aggregates of different varieties produced in each of the locations. Varieties are traded subject to iceberg trade costs.

In each location, there is a continuum of competitive firms that hire labor from unions and produce differentiated goods. Unions get a chance to change their posted wages at some poisson rate. When given the chance, they unilaterally set their wage to maximize the utility of the households in the location.

Households. There is a continuum of households that I index by $\xi \in \Xi$. I will start by describing the dynamic welfare taking as given flow utility before returning to describe the flow utility.

I denote the location of agent ξ at time t by $n^*(\xi, t)$. Then each household starts in some location $n^*(\xi, 0)$ and it gets the opportunity to move at a poisson rate $\delta_\ell > 0$. At that point, the household observes additive utility shocks of moving to every location m $\varepsilon_m(\xi, t)$. The utility shocks are distributed Gumbel with shape parameter ν. The household can then move subject to an additive migration cost of moving to a location m, $\tau_{\ell nm}$.

Denoting the set of all times where household ξ moves from location n to m by $\mathcal{M}_{nm}(\xi) \subset [0, \infty)$. Then realized utility of household ξ is

$$\int_0^\infty e^{-\rho t} \left[U_{n(\xi,t)}(t) + \sum_{n,m} \delta_{t \in \mathcal{M}_{nm}(\xi)} [-\tau_{\ell nm} + \varepsilon_m(\xi, t)] \right] dt,$$

where $U_n(t)$ is the flow utility of living in location n, $\rho > 0$ is household's discount rate, and $\delta_{t \in \mathcal{M}_{nm}(\xi)}$ is the dirac delta function.

The immediate flow utility of a household in location n at time t of type γ, $U_n(t)$ is a function of consumption and labor supply,

$$U_n(t) = \frac{C_n(t)^{1-\theta}}{1-\theta} - \frac{H_n(t)^{1+\eta}}{1+\eta},$$

where $C_n(t)$ is the consumption aggregate, θ is the elasticity of intertemporal substitution, $H_n(t)$ is hours supplied, and η is the Frisch labor elasticity. The consumption aggregate is a cobb-douglas aggregation of consumption of the traded good and the non-traded good,

$$C_n(t) = C_{NTn}(t)^{\alpha} C_{Tn}(t)^{1-\alpha},$$

where $C_{sn}(t)$ is consumption of the sector s good and $\alpha \in (0, 1)$ is the share of spending on non-traded goods. The traded good is an aggregation of the varieties produced in each location,

$$C_{Tn}(t) = \left(\sum_{m \in \mathcal{N}} \phi_m^{\frac{1}{\sigma}} C_{Tmn}(t)^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}},$$

where ϕ_m is the consumption weight on the variety produced by location m, which I normalize so that $\sum_m \phi_m = 1$, $C_{Tmn}(t)$ is consumption of the traded good produced in location m by the consumer in n, and σ is the elasticity of substitution between varieties produced by the locations.

Firms. In each location n, there is a continuum of intermediate producers $\omega \in [0, 1]$ who produce an intermediate using labor. Firm ω produces

$$Y_n(\omega, t) = H_n(\omega, t) \ell_n(t),$$

where $Y_n(\omega, t)$ is production and $H_n(\omega, t)$ is the amount of per capita labor supplied to intermediate ω.

A final producer then combines those intermediates according to a CES aggregator

$$Y_n(t) = A_n \left[\int_0^1 Y_n(\omega, t)^{\frac{\epsilon-1}{\epsilon}} d\omega \right]^{\frac{\epsilon}{\epsilon-1}},$$

where $Y_n(t)$ is the aggregate production of location n and $\epsilon > 1$ is the elasticity of substitution across intermediates. This final good can then be consumed as a non-traded or traded good.

Market Clearing. For the labor market to clear, labor supplied equals the sum of labor demand by each intermediate producer,

$$H_n(t) = \int_0^1 H_n(\omega, t) d\omega, \text{ for all } n, t. \tag{20}$$

Aggregate production of location n is consumed as a traded good and non-traded good. The non-traded good is only consumed by the local households. Trade is subject to iceberg trade costs. Therefore, goods market clearing requires production in location n is equal to consumption of non-traded goods in the location plus consumption of its produce as a traded good across all locations,

$$Y_n(t) = C_{NTn}(t)\ell_n(t) + \sum_m \tau_{nm} C_{Tnm}(t)\ell_m(t), \text{ for all } n, t, \tag{21}$$

where $\tau_{nm} \geqslant 1$ is the iceberg trade costs of delivering a good from location n to location m.

5.2 Decentralized equilibrium

5.2.1 Utility Maximization

I will start by characterizing the household's migration decision taking as given flow utility in location n at time t, $U_n(t)$. I will then turn to the consumption decision. Just as before, workers do not choose labor, and instead supply the labor demanded.

Migration decision. The Bellman equation for a household in location n is

$$\rho v_n(t) - \dot{v}_n(t) = U_n(t) + \delta_\ell \left[V_n(t) - v_n(t) \right], \tag{22}$$

where $v_n(t)$ is the expected lifetime utility of a household in location n at time t and $V_n(t)$ is the expected utility if that households gets the opportunity to move. Because the utility shocks are distributed Gumbel,

$$V_n(t) = \frac{1}{\nu} \log \left(\sum_m \exp(\nu(v_m(t) - \tau_{\ell nm})) \right). \tag{23}$$

This implies that a $\exp(\nu(v_m(t) - \tau_{\ell nm} - V_n(t))$ share of households in location n who have the chance to move will move to location m. The population in location m changes according to

$$\dot{\ell}_m(t) = \delta_\ell \left[\sum_n \exp(\nu(v_m(t) - \tau_{\ell nm} - V_n(t)) \, \ell_n(t) - \ell_m(t) \right]. \tag{24}$$

Intratemporal consumption decision. Given expenditures $E_n(t)$, households in location n at time t choose consumption to maximize utility taking prices as given. In particular,

$$\begin{aligned} \{C_{NTn}(t), C_{Tn}(t), \{C_{Tmn}(t)\}\} \in \underset{C_{NT}, C_T\{C_{Tm}\}}{\operatorname{argmax}} \Bigg\{ (C_{NT})^\alpha (C_T)^{1-\alpha} \Bigg| \\ C_T = \left(\sum_m \phi_m^{\frac{1}{\sigma}} (C_{Tm}^\gamma)^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}, \\ \sum_m p_{Tmn}(t) C_{Tm} + p_{NTn} C_{NT} \leqslant E_n(t) \Bigg\}. \end{aligned} \tag{25}$$

This problem is standard so the characterization is left for the appendix D. We denote by $P_n(t)$ the prefect price index so that $E_n(t) = P_n(t) C_n(t)$.

Households are hand-to-mouth so they spend all of their income in each period. Income comes from two different sources: labor earnings and government transfers. That is,

$$E_n(t) = \left(\int_0^1 W_n(\omega, t) H_n(\omega, t) d\omega \right) + T_n(t), \tag{26}$$

where $W_n(\omega, t)$ is the wage offered by intermediate producer ω in location n and $T_n(t)$ is the transfer to people in location n.

5.2.2 Production

Profit maximization. A competitive, representative firm for each intermediate ω in location n maximizes profits taking prices and wages set by the union as given using a linear technology. Therefore, the price of the intermediate is simply the wage $p_n(\omega, t) = W_n(\omega, t)$.

The final producer is competitive and so maximize profits taking as given the price of the final good $p_n(t)$ and intermediates $W_n(\omega, t)$. Therefore, the usual CES algebra yields

$$Y_n(t), \{Y_n(\omega, t)\} \in \underset{Y, Y(\omega)}{\text{argmax}} \left\{ p_n(t) Y - \int_0^1 W_n(\omega, t) Y(\omega) d\omega \middle| \right. \\ \left. Y = A_n \left[\int_0^1 Y(\omega)^{\frac{\epsilon-1}{\epsilon}} d\omega \right]^{\frac{\epsilon}{\epsilon-1}} \right\}. \tag{27}$$

Trade is also competitive so that $p_{Tnm}(t) = \tau_{nm} p_n(t)$ and $p_{NTn}(t) = p_n(t)$.

Labor unions. For each intermediate ω in location n, there is a union that can unilaterally set the wage it demands. Wages are sticky, and the union only gets the chance to change the wage demanded at a poisson rate δ_w.

Given wages, the union supplies the labor necessary to meet demand for intermediate ω. I assume that there is efficient rationing. When a union gets the chance to change its wage, it sets the wage to maximize utility of the average household in its location. As is standard in this literature, I assume the local government has a wage subsidy to undo the monopoly distortion, funded by a tax on the residents. That is, the unions who can change their wage at time t choose a new wage $\tilde{W}_n(t)$ that solves

$$\tilde{W}_n(t) \in \underset{W'}{\text{argmax}} \int_t^\infty e^{-(\rho+\delta_w)(t'-t)} \left[\frac{C_n(t')^{-\theta}}{P_n(t')} (W')^{1-\epsilon} - H_n(t')^\eta (W')^{-\epsilon} \right] A_n^\epsilon P_n(t')^\epsilon Y_n(t') dt'. \tag{28}$$

Details are in appendix D.

5.2.3 Government

The government sets aggregate spending $E(t)$, such that

$$E(t) = \sum_n E_n(t) \ell_n(t), \tag{29}$$

and also chooses the place specific transfers between locations. The government budget constraint then must hold in each period,

$$\sum_n \ell_n(t) T_n(t) = 0 \text{ for all } t. \tag{30}$$

Definition 2. *Given monetary policy $E(t)$ and per capita transfers $T_n(t)$, an* equilibrium *is a set of location choices $n^*(\xi, t)$, utility levels $U_n(t)$, regional population $\ell_n(t)$, prices $P_n(t)$, wages $W_n(\omega, t)$, consumption levels $C_{Tmn}(t)$, $C_{NT}(t)$, labor supplies $H_n(t), H_n(\omega, t)$, and output $Y_n(t)$, such that:*

- *Households choose consumption and their location to maximize utility* (22)*,* (23)*,* (24)*,* (25)*,* (26)*;*
- *Firms maximize profits taking prices as given,* (27)*;*
- *Unions set wages to maximize expected utility of the local households,* (28)*;*
- *The government's budget constraints hold,* (30)*;*
- *Total spending is equal to nominal GDP* (29)*; and*
- *Markets clear* (20)*,* (21)*.*

5.3 Planner's problem

The government chooses monetary policy $E(t)$, place-based transfers $T_n(t)$ and associated flow utilities

$$U(\xi,t) \equiv U_{n^*(\xi,t)} + \sum_{n,m} \delta_{t\in\mathcal{M}_{nm}(\xi)}[-\tau_{\ell nm} + \varepsilon_m(\xi,t)],$$

to maximize social welfare. Following Dávila and Schaab (2022), I allow the government to have a time varying pareto weight $\lambda(\xi,t)$ on households. That is, the planner could care about the consumption of a household more at some time t than another time t'. I will adjust these time varying pareto weights to justify no government policy in the steady state. However, in contrast to section 4, I will not vary the weights in response to a shock so that my quantification of the optimal poilcy will include insurance reasons for a transfer. Formally, the planner faces the problem

$$\max_{i(t),\{T_n(t)\},\{U(\xi,t)\}\in\mathcal{E}} \int_{\Xi}\int_0^\infty e^{-\rho t}\lambda(\xi,t)U(\xi,t)dtd\xi, \tag{31}$$

where $\mathcal{E}$ is the set of utility profiles attainable in equilibrium, as described in Definition 2.

5.4 Calibration and computation

5.4.1 Linear-quadratic approximation

This is a highly non-linear model with state variables utility $v_n(t)$, population $\ell_n(t)$, along with wages $W_n(\omega,t)$ for each intermediate. Solving the optimal planner's problem with the 722 commuting zones of the United States would be infeasible. Therefore, I follow the macro literature in doing a log-quadratic approximation to the social welfare function and a log-linear approximation to all of the constraints around a no inflation, no fiscal transfer steady state, where pareto weights $\lambda(\xi,t)$ are such that it is optimal before any shocks. Details of how I derive the loss function including distortions in migration, trade, inflation, and output along with the final linearized constraints are in appendix E. I will use $\hat{x}$ to denote

Table 2: Calibration summary.

Panel A. Stimulus effects			
Parameter	Value	Description	Source
$\frac{\alpha}{1-\alpha}$	1.6	Local multiplier	Moretti (2010)
σ	4.5	Trade EoS	Caliendo and Parro (2015)
τ_{nm}		Trade costs	CFS state trade flows
Panel B. Migration effects			
Parameter	Value	Description	Source
$\frac{\nu}{\rho+\delta_\ell}$	2.9	long-run migration elasticity	Hornbeck and Moretti (2024)
δ_ℓ	0.157	Migration calvo friction	ACS migration flows
$\tau_{\ell nm}$		Migration costs	ACS migration flows
Panel C. Other Parameters			
Parameter	Value	Description	Source
ρ	0.06	Patience	Farhi and Werning (2017)
ϵ	11	Intermediate EoS	Farhi and Werning (2017)
η	2	Frisch labor supply elasticity	Peterman (2016)
δ_w	0.3	Wage calvo friction	Figure 1a
θ	1	Intertemporal EoS	log preferences
A_n		Productivity	CBP labor earnings

log deviations from that steady state, and I will consider idiosyncratic demand shocks to the traded output of specific regions ϕ_m.

The final linearized model features 4 state variables for each commuting zone: population $\hat{\ell}_n(t)$, utility $\hat{v}_n(t)$, wage $\hat{w}_n(t)$, and inflation $\hat{\pi}_n(t)$, for a total of 2888. I give details on how I solve the equilibrium and optimal policy for time varying shocks without using an infeasible shooting algorithm in appendix G.

5.4.2 Calibration

In this section, I provide an overview of how I calibrate the model to match the United States in 2000. I interpret a local labor market in the model as a commuting zone (CZ), as developed by Tolbert and Sizer (1996). My analysis will focus on the 722 commuting zones of the contiguous United States, as in Autor et al. (2013). I discuss the key parameters for the stimulus effect and migration effect in detail before turning to the more standard parameters from the macro literature. A summary of how I calibrate the parameters is in Table 2.

Stimulus effects. As I show in proposition D, for a small open region, the stimulus effect of a transfer depends on the local multiplier $\frac{\alpha}{1-\alpha}$ when wages are perfectly rigid. While it does not estimate the local multiplier in response to a government transfer, Moretti (2010) measures the next best thing: how many jobs in the non-traded sectors are created in response to the creation of a new manufacturing job, 1.6. I set α to rationalize what he finds.

With a finite number of regions, the stimulus effect also depends on trade flows between commuting zones. I set the elasticity of substitution across varieties produced by different commuting zones to be 4.5, which is what Caliendo and Parro (2015) estimate when pooling all traded sectors. I do not have data on trade across commuting zones in the United States, so I infer those costs by looking at trade across states. In particular, I assume the iceberg trade costs between two distinct commuting zones n and m are

$$\log \tau_{nm} = \delta_D \log \text{distance}_{nm} + \delta_H,$$

where distance_{nm} is the bilateral distance between the population centroids of CZs n and m. I then guess δ_D and δ_H and find the implied productivity of each commuting zone to match observed employment and earnings. I can then back out the implied expenditure flows between states. I search over δ_D and δ_H to minimize the square distance between the implied share of state's earnings spent on another state and the observed shares from the 2002 Commodity Flow Survey.

Migration effects. As I show in proposition D, the migration effect depends on the long-run migration elasticity $\frac{\nu}{\rho+\delta_\ell}$ and the speed of transition δ_ℓ when wages are perfectly rigid. I set ν to match the average long-run migration elasticity of Metropolitan Statistical Area (MSA) population to earnings found in Hornbeck and Moretti (2024), 2.9.[9] This is not ideal as it is the elasticity in response to earnings rather than a transfer, but under the envelope theorem, the elasticities are the same at the point $T_n = 0$, which determines the sign of the transfer.

The speed of transition is then jointly determined by δ_ℓ and the matrix of migration costs $\tau_{\ell nm}$. I calibrate these parameters using migration reported in the American Community Survey (ACS). In particular, I construct yearly CZ-to-CZ commuting flows from where people report being in the previous year and their current location. This matrix has many 0's so I

[9] As opposed to CZs, MSAs do not cover all of the United States, leaving off rural areas. However, they are similar-sized: some CZs fully encompass an MSA and some MSAs encompass a CZ. Bryan and Morten (2019) find a value of 2.7 for the US and 3.2 in Indonesia, and Hsieh and Moretti (2019) find a value of 3.3. Other papers studying the effect of the China trade shock like Artuç et al. (2010), Caliendo et al. (2019), and Rodríguez-Clare et al. (2020) consider the elasticity across sectors and/or states.

assume that migration costs have the gravity structure

$$\tau_{\ell nm} = \delta_{\ell D} \log \text{distance}_{nm} + \delta_{\ell H}.$$

I then jointly calibrate $\delta_{\ell D}$, $\delta_{\ell H}$ and δ_{ℓ} to match the elasticity of migration to distance and the share of workers who do not move in any given year. I find that $\delta_{\ell} = 0.1575$ which is double the 0.07 Peters (2022) finds in Germany in the post-war years. I also find that, conditional on getting the opportunity to leave, a household will almost always leave. This is consistent with the evidence of Yagan (2019) and Monras (2018) that while population of a region responds to economic shocks, the likelihood of an individual household leaving does not.

Wage Rigidity. The wage rigidity that matters for my mechanism is the relative wage across commuting zones. There is reason to believe that that relative wage rigidity is higher than absolute wages since many firms set national wages (Hazell et al., 2022). Therefore, I set wage rigidity $\delta_w = 0.3$ to match the fact that, for an average commuting zone, the half-life for wage adjustment is just above two years in Figure 1. These are very sticky wages and I will consider how robust the results are to this parameter.

Other Parameters. For patience, ρ, I take the standard value of the literature used by Farhi and Werning (2017). The elasticity of substitution across intermediates ϵ determines the loss from inflation. I similarly set this according to the literature. I take a value of 2 for the Frisch labor supply elasticity η to be closer to the macro estimates of Peterman (2016). And finally, I set $\theta = 1$ implying log preferences.

6 Optimal policy after an idiosyncratic shock

In section 5, I presented a New Keynesian economic geography model and calibrated it to the continental US. In this section, I compute the optimal policy in the average commuting zone after an idiosyncratic demand shock for its traded output. This will allow me to demonstrate how the migration and stimulus effect from Proposition 1 and Proposition 3 interact. I can also assess how effective imperfect policies like unemployment insurance and income tax can be when place-based policy is not feasible. I then show how the optimal changes when there is an aggregate shock like the China trade shock in section 7.

6.1 Impulse response with no policy

I consider a commuting zone with the average amount of home bias in consumption and in migration. Larger locations will have stronger stimulus effects and weaker migration effects on average while smaller locations will have weaker stimulus effects and stronger migration effects. I then simulate a local recession by considering a drop in demand for traded output that match the first year drop in employment of the local projections in section 2, and assuming that every other location in the United States is unaffected. The model is log linear, and so all results can be scaled up or down to consider a different sized recession.

I plot the impulse response functions in Figure 4 when the central government implements a smoothed out version of the observed policies in Figure 2 in black. I compare that to what would have happened in the absence of policy with the blue dotted line, and the optimal policy with the magenta dashed line which I will discuss more below. Every variable is in log differences from its steady state value except for fiscal transfers which are relative to the size of original income.

Figure 4b plots the fiscal transfers to the region. These transfers start around 3.5% of original income, but they slowly fade out over the next 20 years. I assume that the retention rate remains at 1.5% of pre-shock income so that the government continues to provide payments long after the recession has resided.

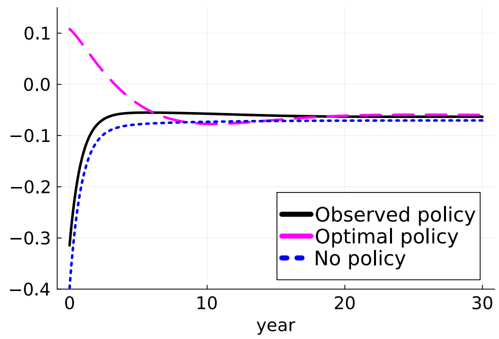
I plot the time path of log wages in Figure 4c. Consistent with the patterns observed in 1a, wages fall for the first 4 years following the shock. Only after that do wages recover slightly as people leave the commuting zone for employment somewhere else. Without the observed policy, the wages would have fallen still further since there is no increased local demand from the policy. Wages would then have recovered more as more people left the region.

While wages did not fall on the impact of the shock, earnings did. I plot the log per capita income in Figure 4a. Immediately on impact, earnings drop by more than 30%, completely driven by a decline in hours. As wages decline, demand for the traded output recovers, and log hours increase back toward their steady state value in 4d. Income recovers to around 5% less than its original amount 5 years after the shock. In the absence of policy, income would have dropped further.

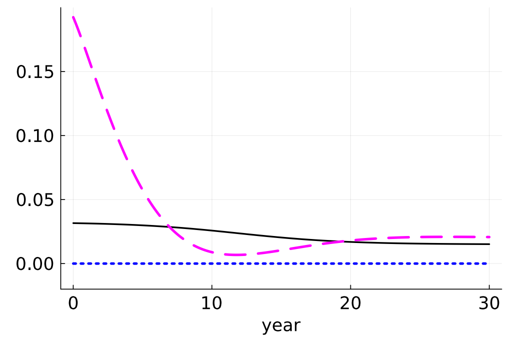
There is no unemployment in this model, but there is a labor wedge. To give an idea of what that might mean for unemployment in response to a demand shock, I plot the log difference between how much the representative worker would like to work relative to how much he does work in Figure 4e. The impulse response suggests that the gap jumps by an entire log point. Unemployment then slowly drops over the next 5 years. In the absence of policy this looks very similar, though the jump is larger.

Figure 4: Impulse response.

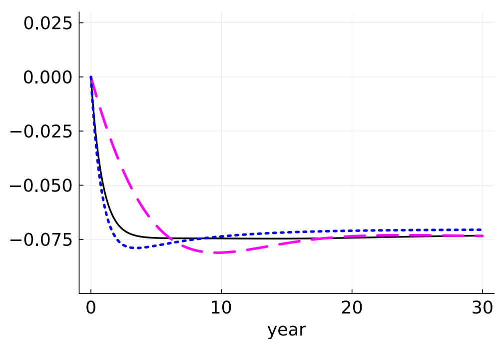
(a) log income



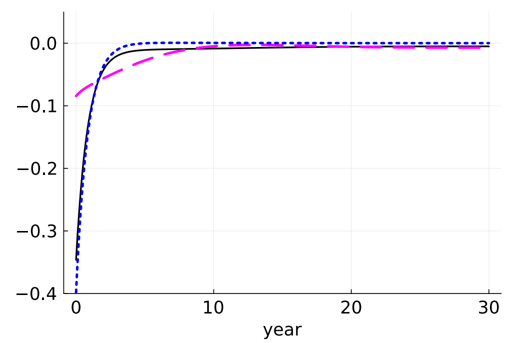
(b) fiscal transfers



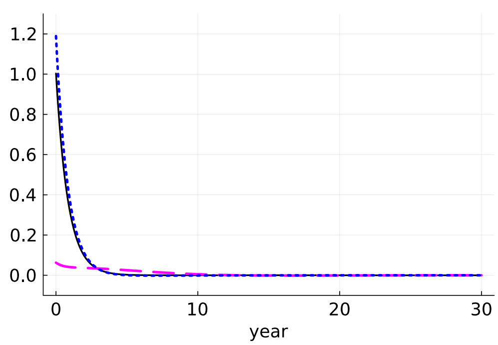
(c) log wage



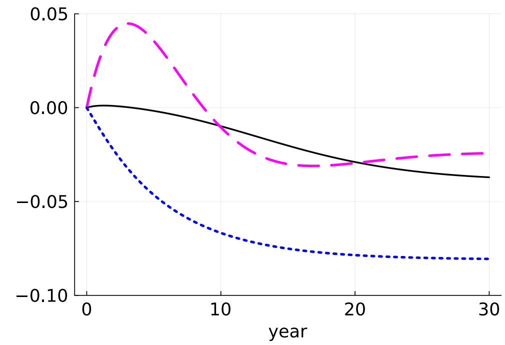
(d) log hours



(e) log underemployment



(f) log population



Note: This figure shows the impulse response in an average commuting zone to a demand shock when under various policies. This is calculated by feeding a demand shock for the average CZ's tradable output into the model described in Section 5 assuming the rest of the country remains unchanged. All values are in log differences from the steady state except transfers which is relative to original income.

Finally, population also slowly adjusts to the new economic situation. People are very slow to move in this model because they rarely get the opportunity. But when they do, they often decide to live somewhere else. In the meantime, very few people outside of the region want to move in. Thus, the population slowly drops more than 4% in the 30 years following the demand shock as shown in Figure 4f. This matches the observed size of the drop in Figure 1b, but the transition is much slower, so I consider robustness to making population adjustment quicker below. By contrast, in the absence of policy, population would drop much quicker and further.

6.2 Optimal policy response

I plot how the national government should respond and what that impies for local economic variables in a magenta dashed line on the same Figure 4. Figure 4b plots the time path of the optimal transfers relative to earnings in the steady state. There are three distinct stages to the optimal transfer that roughly correspond to each of the three roles transfers can play: stimulus, migration, and finally, redistribution.

Stage one lasts for about six and a half years. In this time period, the stimulus effects of the transfer dominate. Immediately after the demand shock, there is a large amount of unemployment, but people do not have time to move in response to government policy, so the government can get free stimulus by giving people a check immediately upon being laid off. Thus, optimal transfers jump to around 20% of the original commuting zone income. In fact, the transfers are so large, one can see in Figure 4a that total income of the region actually increases. This efficiently puts the people without a job back to work doing non-traded production for the local population. Because of that, log underemployment in Figure 4e peaks around 6% log points of initial labor supply rather than more than 100% increase seen with observed policy. Optimal transfers then taper in size as the migration effect of the transfer becomes more important.

In stage two, the migration effect of the transfer dominates, consistent with Proposition 3. This lasts from year 7 to around year 20 and features transfers that are lower than the long run redistributive transfers. After the demand shock, the planner commits to an entire time path of fiscal transfers. That means the very generous transfers in the immediate aftermath of the shock, but it also includes a promise to tax people who stay in the commuting zone in the medium run (around 10 years after the shock). Because of that promise, workers who get the opportunity to move to a different location (because of a new job opportunity, etc.) take it. Thus, the planner can have her cake and eat it to. She can get the immediate stimulus with the front loaded transfers while still encouraging workers to find work elsewhere through the promise of future taxes. Therefore, the bump in population in Figure 4f is relatively small, even though the transfers immediately after the demand shock are quite large.

The third stage is the long run, more than 20 years after the shock. At this point, wages have completely adjusted and population has started to stabilize. There is no longer any reasons for policy to affect macroeconomic stabilization. This transfer optimally trades off redistribution to people who are now poorer because of the shock against misallocation that comes from worker' migration response as explored in Gaubert et al. (2021).

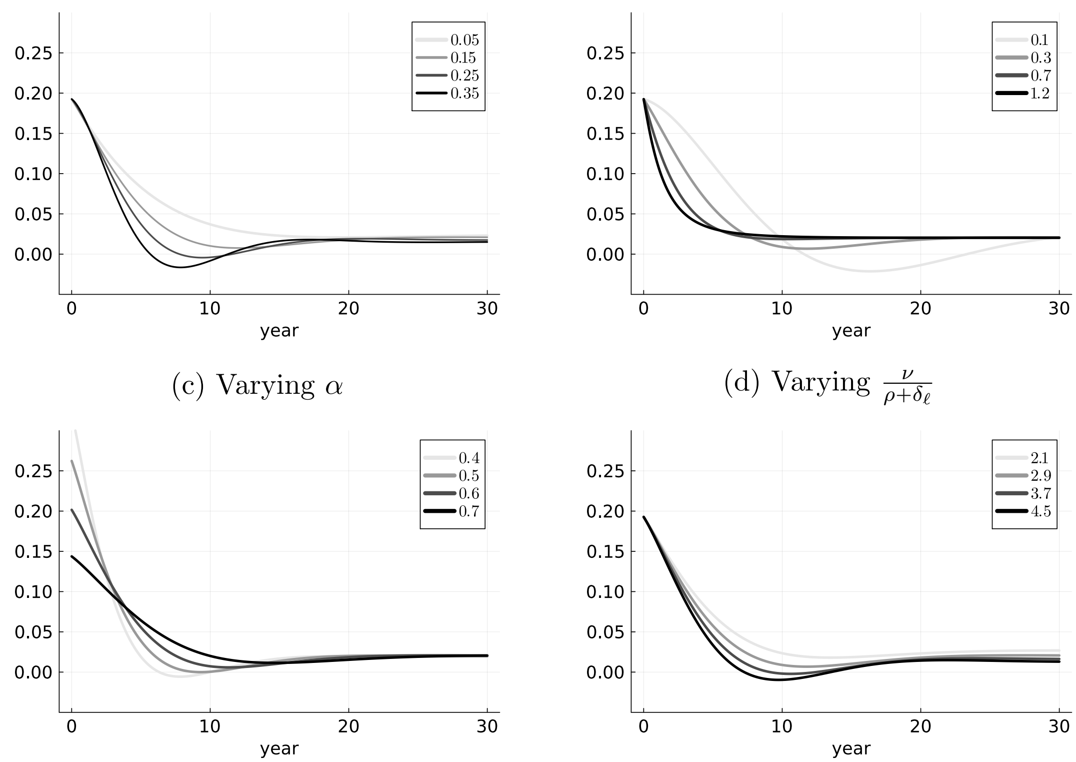
The observed policy falls short in two main ways. First of all, it is not nearly generous enough immediately after the demand shock, so that unemployment rises inefficiently high. It then also does not fade away quickly enough, encouraging workers to remain in the area for too long. In particular, transfers driven by the retirement and disability programs seem to hurt macroeconomic stability. However the observed poilcy does a decent job at matching the long run optimal insurance. In the end, the observed policy achieves 35.4% of the welfare gains offered by the fully optimal policy.

Robustness. Next I assess how sensitive the optimal policy is to different parameters. In particular, I plot the time path of optimal transfers in response to a demand shock while varying key parameters determining the relative strength of the migration and stimulus effect in Figure 5. In Figure 5a, I vary the speed of migration δ_ℓ, holding fixed the long run migration elasticity. Figure 5b varies the degree of wage rigidity. Figure 5c shows how the policy changes with the local multiplier, and Figure 5d shows how sensitive the policy is to the long run migration elasticity.

I start by discussing how the speed of population change affects the optimal policy in 5a. When population adjusts very slowly (i.e. δ_ℓ is close to 0), the optimal transfer never falls below the long run insurance level. That is because the planner cannot affect population on the time scale necessary to affect the recession. People might be very mobile in the long run, but if they will only move out 10 years after a policy change, there is no macroeconomic benefit because wages will have already adjusted by that point. When people are very quick to move, as suggested by the impulse response in Figure 1b, the migration effect becomes more important because people's migration decision is very responsive to planned taxes. Therefore, when $\delta_\ell = 0.35$, the optimal transfer becomes negative not even 7 years after the demand shock. It then rises back to the same level of long run insurance transfers.

Next I vary the speed with which wages adjust in 5b. Similar to δ_ℓ, varying δ_w plays a large role in how important the migration effect is. The main difference is that while increasing δ_ℓ speeds up the movement of households so they can respond while the recession is happening, decreasing δ_w slows down the wages so that the recession is still happening

Figure 5: Optimal Policy Robustness.



(a) Varying δ_ℓ (b) Varying δ_w (c) Varying α (d) Varying $\frac{\nu}{\rho+\delta_\ell}$

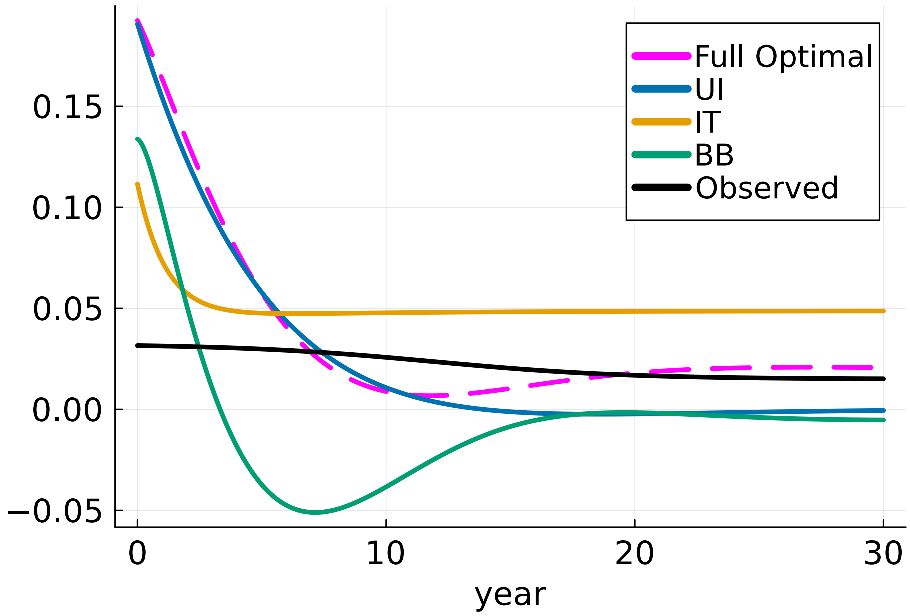
Note: This figure shows how the optimal policy changes with various parameters

while population slowly adjusts. Thus, as wages become perfectly rigid (i.e δ_w becomes very small), the optimal transfer becomes negative for a large number of years following the demand shock. As wages adjust quicker, migration cannot react in time so that the transfers never drop below their long run insurance levels. However, the basic structure of generous transfers that quickly fade out remains robust.

Varying the home bias in consumption α has very different impacts on the optimal transfers as seen in 5c. Increasing α makes stimulus payments much more effective. Therefore, as $\alpha \to 1$, the stimulus effect always dominates the migration effect so that there is no large dip in the optimal transfer around year 10. However, when transfers are very effective at stimulating the local economy, the government does not need to transfer as much money to a region in a recession to stimulate it. Therefore, at time 0, the optimal transfer is actually decreasing in the degree of home bias.

Finally, I show how the optimal transfer changes with the long run migration elasticity in Figure 5d. Increasing that elasticity changes the insurance effect because it increases the misallocation caused by giving a small transfer to the region. Therefore, the optimal long run transfer decreases in the migration elasticity. This comparative static also changes

Figure 6: Imperfect Policies.



Note: This figure plots optimal policy against various imperfect policy instruments

the migration effect. When people's location choice is more responsive to transfers, the government will want to tax a recessionary city more to encourage people to get out. Thus, the optimal transfer becomes negative around year 10 if the long run migration elasticity is 3.7.

6.3 Alternate policy instruments

While the United States might never have access to fully optimal place-based taxes, it could make adjustments to its current programs of automatic stablizers so that they do a better job of ensuring macroeconomic stability for cities going through recessions. In this section, I assess how well these automatic stabilizers could work to fight local recessions when we account for the stimulus and migration effects of policy. In particular, I will consider 3 types of policies: unemployment insurance, income tax, and local budget balance. I model unemployment insurance as a transfer to the region that must be proportional to the labor wedge. With the income tax, the transfer must be proportional to lost income. Local budget balance is different. I assess how effective policy can be when it is constrained to have a present discounted value of 0 taking as given the taxes and transfers currently offered by the national government. I optimize over the possible policies within each class and assess how well they can compare to the full optimal policy in response to the idiosyncratic demand shock to a commuting zone.

I plot the time path of transfers for the best policy within each class in Figure 6. The fully optimal policy and the observed policy are both reprinted for easy comparison. The optimal unemployment insurance does a very good job of matching the general shape of the fully optimal policy. It allows for extremely generous transfers on impact that decay over the next ten years as wages adjust. Compared to the fully optimal policy, it only fails to recover and offer the efficient long run insurance. Yet, despite that, it still manages to achieve 94.7% of the welfare gains of the fully optimal transfer. This unemployment insurance policy is much more generous than any reasonable unemployment insurance system. It suggests that each unemployed person should get a transfer equivalent to 5 times their original income. While that does not make sense as an individual transfer, it does suggest that the central government could transfer money to commuting zones that have high unemployment rate shocks. It also suggests that the federal government should consider making the special benefits authorized for periods of high unemployment more generous.

The income tax has a small bump in transfers on impact, but it then falls close to its long run level after 5 years. This high long run transfer implies that it continues to distort migration too much, both in the medium run and long run. The income tax only manages to get 65.6% of the welfare gains of the fully optimal policy even while it makes up 50% of the lost income in the commuting zone.

Turning to the budget balanced policy, I find that a local government can fight a local recession by borrowing to fund a large stimulus program after the demand shock. The stimulus is not enough to increase income on impact, but it does put many of the households back to work. The local government then pays for that policy with taxes in the medium and long run. By taxing heavily around year 8, the local government can encourage people to leave and find good employment somewhere else at the same time it funds its stimulus payments. The government then settles in with a moderate long run tax to make up the rest of the shortfall. With this policy, and no change in the central government's tax and transfer program, a local government can get 74.7% of the welfare gains from the fully optimal policy, much better than the 35.4% implied by the current policies.

6.4 Discussion and Robustness

In a dynamic setting, the stimulus and migration effects are not in direct conflict. A transfer immediately after a demand shock can stimulate the economy while a transfer 10 years after a demand shock will just have the migration impact. This basic insight is robust to including other frictions though exact numbers might change.

Optimal savers. In appendix I, I include families in each location that optimally choose consumption and saving. This weakens the stimulus effect of a transfer since the marginal propensity to consume is less than 1. Thus, it generically strengthens the migration effect compared to the stimulus effect.

Fixed cost of moving. Suppose that there is a fixed cost in goods that households need to pay in order to move. In that case, the front-loaded transfers would have stimulus and migration effects. Thus, the planner has reason to make transfers more generous immediately after the shock.

Scarring effects. Suppose that there are scarring effects that come from being in a region going through a recession as suggested by Yagan (2019). Then the front-loaded transfers would limit unemployment in the short-run while encouraging workers to move else where their skills can be productively used and built upon. Thus, this policy limits the amount of skill loss.

7 Optimal policy after the China trade shock

In section 6, I analyzed how place-based policy should react to an idiosyncratic demand shock to a single region. In this section, I consider what the regional recessions cause by the China trade shock imply for optimal fiscal policy. With the full model and a spatially correlated shock, I can assess how the migration and stimulus effect change as suggested by Proposition 2.

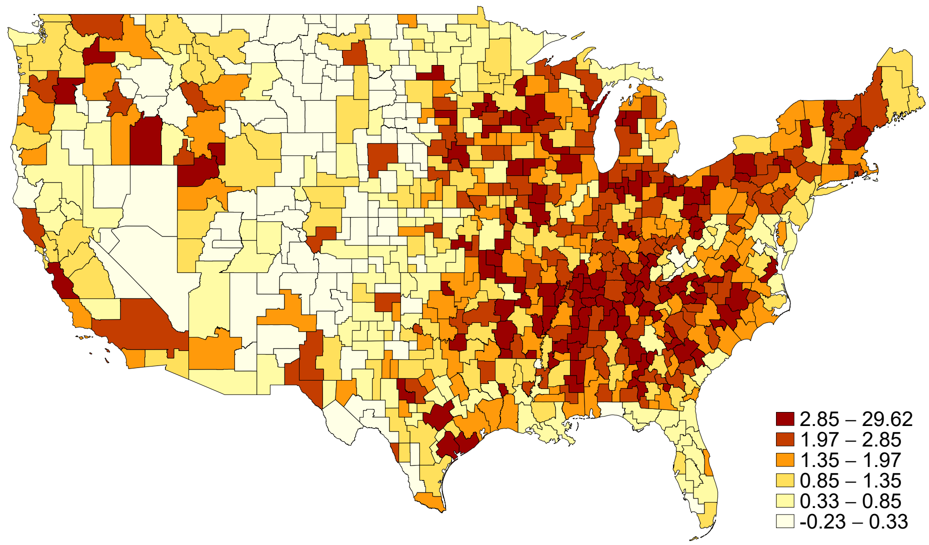
7.1 The trade shock

I model the trade shock as a uniformly increasing demand shock for traded production of the regions starting in the year 2000 and ending at the beginning of year 2007. I further assume that starting the year 2000, the planner fully anticipates the size of the entire trade shock. I follow Adao et al. (2019) in constructing the China Trade shock to each commuting zone. The decrease in demand for commuting zone n's traded output is

$$\hat{\phi}_n = -\sum_s \ell_{n,s} \Delta M_{China,s},$$

where $\Delta M_{China,s}$ is the change in imports for the years 2000 to 2007 from China in the 4-digit SIC sector s for a set of high-income countries divided by the US initial employment

Figure 7: China shock spatial incidence.



Note: This figure plots the incidence of the China Trade shock across the 722 comuting zones of the contiguous United States. The shock is constructed using the increase in Chinese exports in 4 digt industries to other advanced countries from 2000 to 2007. The impact on each commuting zone is determined by share of commuting zone employment in the sector in year 2000.

in sector s, and $\ell_{n,s}$ is commuting zone n's employment share in sector s in the year 2000. I plot the distribution of shocks in Figure 7.

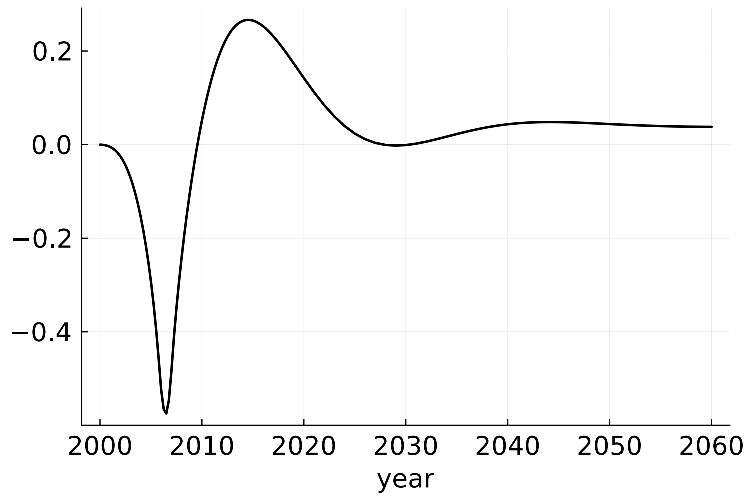
7.2 Average Optimal Policy

I start by plotting the impulse response function for the average commuting zone hit by the China trade shock. In particular, I weight commuting zone n by its earnings, population, and the size of the shock, i.e. $E_n \ell_n \hat{\phi}_n$, and take the average value of the transfer. I plot the results in Figure 8.

The time path of the transfers is significantly different from that found in Section 6 because starting in the year 2000, the planner expects future shocks. Therefore, the planner actually wants to encourage people to move out of the commuting zones before the worst of the China trade shock. In 2000, the planner promises 0 taxes because transfers announced right away have no impact on anyone's choice to move. However, by promising to tax workers in the future, with the largest taxes in 2006, the planner get some people to leave the region. This completely depends on the planner foreseeing the China shock. If the planner did not know how bad the shock would be, the optimal transfer would be positive in the year 2000, and then continue to grow as the shock became increasingly worse.

After 2006, the optimal transfer to regions hit by the China shock start to increase, becoming positive before the year 2010. At that point, the stimulus effect of a transfer

Figure 8: Weighted Optimal Policy to China Trade Shock.



Note: This figure plots the transfers to commuting zones hit by the China trade shock, weighted by labor earnings and the size of the shock.

dominates, and the planner starts transferring lots of money to the regions in a recession. The stimulus effect continues to dominate the subsequent migration effect after the shock until 2024, a full 17 years after the China trade shock fully stopped. This is much longer than the 7 to 10 years found in Section 6 in response to an idiosyncratic shock. And it suggests that perhaps the take up in disability insurance that Autor et al. (2013) noted after the shock actually could have helped with the macroeconomic stability of the country. After the China shock, many people did not have other places to go, so long run transfers from the government could provide stimulus without distorting migration decisions much.

After 2024, the migration effect again dominates. The optimal transfers drop below their long run redistribution levels so that workers are encouraged to find jobs elsewhere..

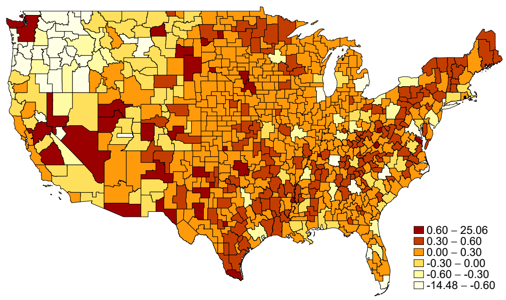
7.3 The geography of optimal policy

The average policy hides a significant amount of spatial heterogeneity. I plot some of that heterogeneity in Figure 9.

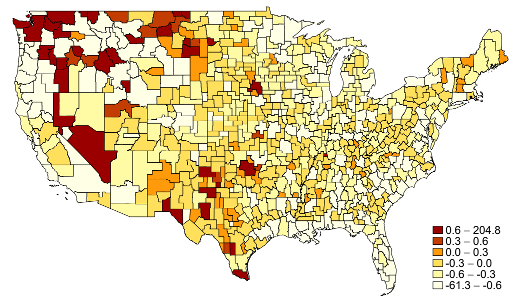
In the year 2002, Figure 9a, transfers are on average taxing the regions hit by the China trade shock. This is seen most clearly in the Northwest where there are a lot of taxes centered on the commuting zones in Eastern Washington soon to be most affected. However, the positive transfers are often targeted at commuting zones near the areas with a shock. For example, the planner gives generous transfers to northern Minnesota, Louisiana, and Eastern California or Nevada. These are regions that workers about to be affected by the China shock would move to before the shock hits. By 2006, Figure 9b, the transfers are far

Figure 9: Optimal Transfers.

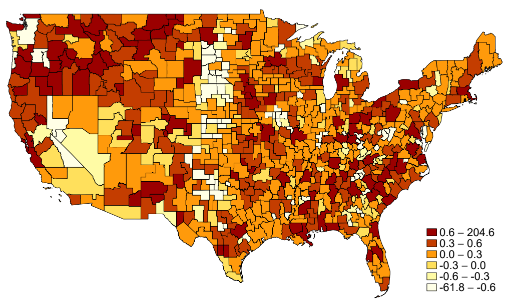
(a) 2002



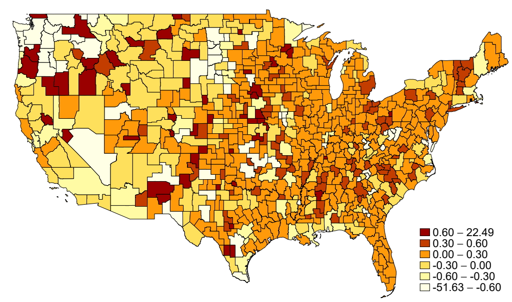
(b) 2006



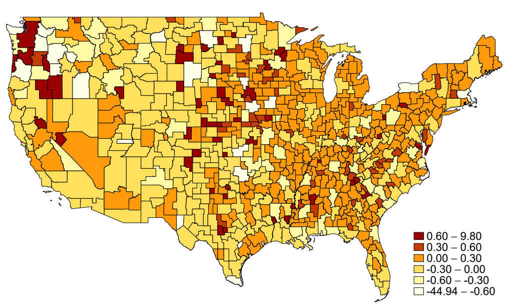
(c) 2017



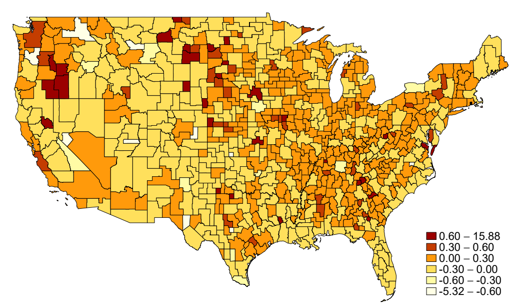
(d) 2024



(e) 2030



(f) 2040



Note: This figure shows the impulse response in an average commuting zone to a demand shock when under various policies. This is calculated by feeding a demand shock for the average CZ's tradable output into the model described in Section 5 assuming the rest of the country remains unchanged. All values are in log differences from the steady state except transfers which is relative to original income.

more concentrated in regions far away from the China shock, and there are taxes on most areas near the shock. The only exception to this is the northeast where the planner has already started providing stimulus to regions in Eastern Washington.

By 2017, transfers are targeted toward all commuting zones directly affected by the China shock. But the government also gives transfers to commuting zones near those directly affected. Those transfers nearby serve three purposes. First, the China shock indirectly hurts those regions since a decline in income of nearby regions reduces spending on the unaffected region because of trade costs. Therefore, those regions also experience a recession. Adao et al. (2019) discuss this extensively. Second, since there are trade costs, giving money to commuting zones near regions in a recession will lead to some stimulus for the commuting zone in the recession. Finally, those transfers encourage people who live in nearby commuting zones to move to the region that is not as badly affected. This is exactly Proposition 2. The stimulus transfers become less generous by 2024.

In 2030, the planner then follows through on her plan to reduce transfers to regions that had bad recessions during the China shock. The taxes then settle in at their long run insurance levels around the year 2040.

8 Concluding remarks

Regions are subject to idiosyncratic shocks. Changes in trade policies can lead to large shifts in demand. Economic structural change can make the product one location produces less enticing. And idiosyncratic shocks to individual firms can end up greatly hurting a town. Central governments cannot use monetary policy to fight the resulting local recessions, but it can use other policies. When designing those policies, government needs to be careful because externalities and market imperfections shape how a region responds to that shock.

In this paper, I focused on one particular imperfection: wage rigidity. And I showed that fiscal policy can be used to fight the resulting local recession. Any transfers should be aggressive, but short lived. For idiosyncratic shocks, more generous unemployment insurance could provide the necessary stimulus without distorting location choice greatly. More aggregate shocks likely call for a more coordinated response.

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