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Productivity differences and inter-state migration in the U.S.: A multilateral gravity approach

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ABSTRACT

In this paper, we study the quantitative role of productivity differences in explaining migration in presence of multiple destination choices. We construct a dynamic general equilibrium model with multi-region, multi-sector set-up where labor is a mobile input, which adjusts to regional and sectoral productivity shocks, resulting in migration across regions. The proposed model generates a migration network where the flow of migrants between any two regions follows a gravity equation. We calibrate the model to the U.S. data and we find that variation in industrial and regional total factor productivity shocks explains about 63% of the interstate migration in the U.S. Finally, we perform comparative statics to estimate the effects of long-run structural changes on migration. We find that capital intensity of the production process and the demand for services over manufactured goods negatively impact aggregate level of migration whereas asymmetries in trade patterns do not appear to have substantial effects.

1. Introduction

The gross flow of people across a pair of regions is typically seen to be proportional to the respective populations and inversely proportional to the geographic distance, an empirical regularity known as the gravity model of migration (Anderson, 2011). In this paper, we consider three questions based on this observation. First, what is the quantitative role of productivity differences across regions in explaining region to region yearly migration? Second, when people decide to migrate in presence of multiple destinations, why does a gravity equation hold across each pair of regions, i.e. can we explain the empirically found multi-lateral gravity equations via productivity differences across multiple regions? Finally, in the long run, what are the effects of the industry structure and trade patterns on the aggregate level of migration? We address these questions by providing a theoretical foundation to the empirical studies that use the gravity equation to analyze region to region migration flows. In particular, we quantitatively explain the magnitude of interstate migration in the U.S. by productivity differences in presence of multiple destinations.

We model an economy comprising smaller regions sharing largely similar economic background (identical labor laws, integrated financial markets, etc.), connected to each other by linkages though trade and migration. If the constituent regions receive asymmetric productivity shocks, we would expect workers to migrate from the low-productivity regions to the high productivity regions, in a friction-less world. Therefore, the process of migration would manifest itself in two forms. First, there would be flow of workers between all pairs of regions. Second, the total mass of migrants, i.e. the workers that were displaced due to the realization of the productivity shocks, will pin down the aggregate level of migration.

In the following, we construct an N-region, two-sector model augmented with sector and region specific idiosyncratic productivity shocks. The basic inputs are capital and labor which are respectively assumed to be fixed and movable in the short-run. Capital and labor are used to produce intermediate goods. Producers produce the final goods in the two sectors (service and manufacturing) by combining the intermediate goods and both the final goods are consumed within the regions. The intermediates used in the manufacturing sector are traded across states. Labor being the only movable input (capital is fixed), in face of different cross-sectional realization of shocks, would adjust across states according to the relative attractiveness based on productivity. For each year, we treat initial distribution of population across states as a set of labor allocation. After realization of shocks, from one set of labor allocation, we reach another set such that utilities are

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equalized across the states restoring equilibrium. The underlying logic is that migratory responses are ultimately utility enhancing[1] (Ashby, 2007).

Fig. 1 shows the distribution of population within U.S. in 2007 and Fig. 2 shows the network formed from migration across states within one year. As can be seen comparing these two figures, there are hubs of migrants (e.g. California – abbreviated as CA, see Fig. 2) which also have a large mass of population (Fig. 1) indicating that pair-wise flow of migrants depends on the relative population across states. The model described below, captures exactly this feature. For modeling purpose, we borrow from the recently blooming literature in international trade theory in the tradition of the Eaton and Kortum (2002) model (and its subsequent modifications by Alvarez and Lucas, 2007) that combines a rich description of the production processes in a multi-region set-up, capturing the propagation of shocks across regions through adjustable, i.e. movable productive inputs. The analytical structure provided by Caliendo et al. (2014) helps us to explicitly pin down the effects on labor allocation. We show that a similarly specified model can serve as a benchmark case for a frictionless world. With repeated productivity shocks, the model generates a network of migration. The basic parameters describing the model are given by the trade network structure, preferences of the households and the production functions.

The driving mechanisms in the model are two-folds. The first one is a pure general equilibrium channel which captures the labor flow as an outcome of sectoral reallocation process due to productivity differences across sectors. The second one is the trade channel through which we quantify the inter-region labor flow due to spill-over of productivity shocks due to the trade process. In general, the essential mechanism can be thought of as a planner's problem where the planner treats (perfectly divisible) labor as a movable productive input and allocates it across regions according to productivity shocks realized in different regions (see also Kennan and Walker, 2011; Bertoli et al., 2013).

We calibrate the model to the U.S. using standard parameter values to produce quantitative results. The model generates a migration network which is reasonably consistent with the U.S. data in terms of state-to-state migration as well as the total mass of migrants. In particular, the model predictions of state-to-state migration accounts for about 63% of the actual state-to-state migration. Finally, we perform comparative statics to understand the impact of changes in the macroeconomic fundamentals on the aggregate migration. We show that capital intensity has a large impact on migration, household preferences over manufactured goods vs. services have a smaller impact on migration whereas the impacts of asymmetries in trade linkages are not very significant.

The theoretical and empirical justifications for modeling factor flows (labor in the present context) using gravity equations come from Anderson (2011), who derives a gravity equation for migration in a small-scale general equilibrium framework. In particular, the derived gravity equation embeds the inward and outward resistance to migration (as proposed by Anderson and van Wincoop, 2003 in the context of trade) and it is analogous to Eaton–Kortum type trade gravity equations. Our model generalizes the structure significantly in its ability to handle trade flow as well as migration across multiple destinations. Within a fully structural set-up, this allows us to understand the directions of long-run changes in migration. Albeit different in scope, Michaels et al. (2012) provide a theory of structural change which can be interpreted as bilateral migration, based on a similar trade theoretic structure. An expanded framework was used by Redding (2016) to study the welfare gains from trade. As such the present contribution is an attempt to provide a dynamic general equilibrium model that builds on trade theoretic literature to explain the labor migration (Goston and Nelson, 2013).

There is a huge empirical literature on migration and various factors that magnifies or lessens it. Serrano-Domingo and Requena-Silvente (2013) empirically studied migration–trade linkage and related ethnic diversity to external trade. In our theoretical model, we explicitly address the linkage by providing a fully specified trading structure across the states. However, we assume labor to be homogeneous and hence, inherent diversity (for example, ethnicity) does not enter our model. Treyz et al. (1993) were an early attempt that considered a behavioral model of migration and using time-series data showed that migration is affected, among others, by relative employment opportunities, relative wages, industry composition and local amenities. In our theoretical model, the first three effects have been explicitly taken care of. Klein and Ventura (2009) construct a growth model to study the welfare gains from removing barriers to migration as there exists substantial productivity differences between the countries (see also Klein and Ventura, 2007 for the theoretical analysis of the dynamic model). However, they focus on the historical evolution of the migration pattern and study aggregated data. In the recent literature, researchers have focused on the migration-FDI nexus (see Section 5 for a detailed discussion). In the current structure of the model, we assume fixed capital stock for the sake of simplicity. Potential effects of various types of frictions on migration have been studied in details. For example, Kaplan and Schulhofer-Wohl (2013) study the reason behind the secular decline in the U.S. interstate migration over the last two decades and find reduced geographic specificity and higher information about the states to be important factors. See Molloy et al. (2011) and Coen-Pirani (2010) for a detailed overview of the interstate migration in the U.S. Magee et al. (2015) discuss an interesting approach to study the relationship between migration and consumption patterns with social factors. In the following section, we propose a model to capture annual bilateral migration between different pairs of states.

2. A model of migration

We consider an economy where each year N states experience idiosyncratic shocks T times and the workers can move across the states depending on the relative intensities of the shocks. Each state is populated by a continuum of homogeneous households. There are tradable intermediate inputs and non-tradable final goods produced by firms in each state for the consumption of the households. For fixing the notion, we assume that manufacturing industry constitutes the tradables and the service industry produces the non-tradables. Each of the final goods producing industries also produces a continuum of intermediate goods using local labor and a local fixed capital stock. This stock might be interpreted as the structures and land which does not grow over time or at least grows at a much slower pace than labor movement. The states trade on intermediate inputs. The final goods are only for consumption. The household supplies its labor to both sectors in the home region. Since the states have their idiosyncratic productivity shock processes and labor is the only mobile factor, sector and state-specific productivity shocks will lead to multi-lateral flow of labor across sectors and states. This feature is obtained from the model proposed by Caliendo et al. (2014). The flow of workers from one state to another is interpreted as migration.

2.1. Households' problem

In each state a continuum of households constitutes the demand side. They are the sole suppliers of labor which is used in the local production processes. There are two final goods, tradables (M) and non-tradables (S).[2] The instantaneous utility function of households in

[1] Tiebout (1956) makes an interesting observation that with low rigidities in labor market and no asymmetries in information or externalities induced by government, the consumers would reveal their preference through migration. This idea of 'voting with feet' is found to have significant empirical support (Banzhaf and Walsh, 2008).

[2] We follow the convention that manufacturing industries constitute the tradable sector and the service producing industries constitute the non-tradable sector. Note that neither of the final goods is traded. Only the intermediate inputs in the manufacturing sector can be traded.