A DMP model of intercity trade

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A R T I C L E   I N F O

A B S T R A C T

Job matching, a central feature of DMP theory, requires contacts between prospective employers and employees. This paper assumes that they may be either face-to-face and take place at city centers or via referrals from social contacts. The paper presents a model of an economy whose urban structure consists of cities of different types. All cities produce a non-tradeable final good using ranges of tradeable intermediate varieties. Each city has an internal spatial structure: individuals commute to the CBD in order to work, when employed, and to seek jobs, when unemployed. Hiring by each intermediate producing firm is subject to frictions, which are modeled in the Diamond–Mortensen–Pissarides fashion. City type is conferred by specialization in producing one of two types of intermediate varieties and there is intercity trade in intermediate varieties. The paper examines properties of equilibrium with intercity trade and its dependence on various parameters and their consequences for unemployment, output and welfare across the economy along a steady state. The model's use of international trade tools confers a central role to labor market tightness, akin to factor intensity. A natural dependence of unemployment on city size is generated. Equilibrium outcomes generically diverge from the planner's optimum: there exists mismatch generically. Socially optimal unemployment trades off the probability of employment to search costs of firms independently for each skill type and independently of city size. Socially optimal city sizes are independent of the matching model and therefore labor market tightness considerations but reflect both market size effects and the skill composition of the economy.

1. Introduction

The Great Recession of 2007–2009 and its aftermath are amply demonstrating the importance of spatial variations in unemployment and economic activity. Not all parts of the US economy and not all economies of the world have been equally affected by it. The housing bubble has been most pronounced in some areas of the US, some of which experienced very dramatic declines in house prices. Some of those particular areas have experienced robust recoveries, while other areas are particularly slow in recovering. The variation of employment dynamics over the business cycle across federated states, regions and cities in large economies is particularly interesting. The present paper aims specifically at a better understanding of variations in economic activity and unemployment across an economy's cities while accounting for intercity trade. An urban perspective is made possible by a synthesis of new economic geography and urban economics, on the one hand, with the economics of markets with frictions, famously modeled by the Diamond-Mortensen-Pissarides (DMP) model, on the other.

The present paper proposes a coherent and firmly micro-founded theoretical model of urban unemployment in an economy of open, trading cities. The approach proposed here enhances the system-of-cities model by allowing for unemployment and fluctuations in economic activity that may differ systematically across cities in a large economy. It also enhances the DMP model of labor markets with frictions by introducing, in addition, spatial frictions of the sort that characterize urban economies. The model's use of international trade tools confers a central role to labor market tightness, akin to factor intensity. Equilibrium modeling of cities lends additional discipline to analyses of urban unemployment and provides a systematic way of exploiting Beveridge curves, as well, as an expository tool. A specific application via job referrals by social contacts is another novel feature. The model is cast in terms of certainty equivalents, which is in line with the original DMP literature. Equilibrium outcomes generically diverge from the planner's optimum: socially optimal unemployment trades off the likelihood of employment against search costs of firms, independently for each skill type and independently of city size. Socially optimal city sizes are independent of labor market tightness considerations but reflect both market size effects and the skill composition of the economy.

The present paper adopts a DMP approach, really following Pissarides (1985, 2000), embedded in a system-of-cities model, following Henderson (1974, 1987) as adapted by Fujita et al. (1999). It aims at accommodating the increasing mainly empirical literature on urban macroeconomics. Cities are specialized in terms of different

ranges of differentiated intermediate varieties they produce. Only the intermediate varieties are tradeable, and are used by means of a Cobb–Douglas production function to produce in each city a final consumption good, which is neither storable nor tradeable. Each variety is produced by a single firm, which uses labor as its only input. There are two types of varieties, $\alpha-$ and $\beta-$ varieties, with each being produced by a correspondingly different kind of labor in a monopolistic competition setting. The groups of firms producing the respective varieties make up the $\alpha-$ and $\beta-$ industries. Cities specialize by producing either type of varieties, provided they host the appropriate kind of labor.

Each intermediate producing firm hires in a frictional labor market, modeled in the standard Mortensen–Pissarides fashion. For simplicity I assume that jobs are destroyed at constant rates for each type of labor, and that forces individuals and firms back to the labor market. Matching of workers and vacancies is city-specific. Individuals maximize expected utility of consumption. Individuals need to travel to the central business district of the city where they reside in order to work, when employed, and to be matched, when unemployed. However, proximity is costly in terms of congestion, which in turn generates a land rent gradient. Locations nearer the city center are more attractive, but land rents adjust so as identical individuals be indifferent as to where they locate. The paper also examines matching via referrals from social contacts. The model of intercity trade in this paper in accommodating labor market frictions highlights the role of labor market tightness in intercity resource allocation that serves as a counterpart of factor intensities in conventional international trade models. A comparison between equilibrium allocations and those of a planner's problem concludes the paper.

1.1. Review of the literature

Business cycle phenomena that have been addressed in urban contexts involve primarily measures of employment fluctuations. Taking cues from Helsley and Strange (1990), who have an explicit urban setting in mind, In broadly related research that emphasizes unemployment, Gan and Zhang (2006) link city size to matching efficiency. Simon (1988) argues that the more industrially diversified a city is the lower its frictional unemploymentn broadly related research that emphasizes unemployment, Coulson (2008) points to a comparison of three MSAs, Los Angeles, CA, Detroit, MI, and San Jose, CA over the period 1956–2002 [*ibid.,* Fig. 1]. While all three have employments that are trending upward over time during that period, the rate at which their employments do so certainly varies across cities and over time within cities.[1] High persistence in metro unemployment rates is documented by Kline and Moretti (2013), who develop a simple model of local labor markets and use it to study the effects of place-based policies in the form of local job creation programs.

Recent research throws additional light at employment and unemployment variations across US cities. Rappaport (2012) works with three possible explanations: one, skill mismatch of workers in high unemployment metro areas with the hiring needs of firms elsewhere; two, some metro areas offer intrinsic characteristics that make households and firms unwilling to move; three, high moving costs support long term divergence in metro unemployment areas. Rappaport's empirical analysis supports all three explanations. Metro workforce characteristics account for the largest share of the variation in metro unemployment rates, when measured over complete business cycles. Characteristics more intrinsic to metro areas themselves account for much of this variation as well, though not as much as workforce characteristics. Estimated moving costs are sufficiently high to some households unwilling to move away from high-unemployment metros.

Proulx (2013) finds that estimates for Okun's laws for U.S. MSAs show moderate to high cross-sectional dependence, a result which is robust to a number of different spatial proximity measures. In fact, the cross-sectional dependence appears to increase if instead of distance-based economic similarity-based measures are used. Decomposing the total effect of changes in the growth rate of real MSA GDP on the unemployment rate shows that the indirect effect of growth in GDP in neighboring cities dominates the direct effect of growth in local GDP.

Of relevance to the present paper is the international trade literature that emphasizes labor market frictions, such as Davidson et al. (1999), who examine basic international trade issues in the light of frictional labor markets, and Costinot (2009) who rationalizes a positive association between unemployment and trade protection. Labor market flexibility as a source of comparative advantage is examined by Cuñat and Melitz (2012); Helpman and Itskhoki (2010); Helpman et al. (2013) and Tang (2012) develop international trade models that emphasize frictional labor markets.[2] Dutt et al. (2009) develop a simple model of international trade with search induced unemployment and show empirically that trade liberalization increases unemployment in the short run but reduces it in the long run, as economies adjust to a new steady state.

Anderson et al. (2007) report that thicker urban labor markets are associated with more assortative matching in terms of worker and firm quality and that production complementarity and assortative matching is an important source of the urban productivity premium. Bleakley and Lin (2012) confirm these findings with US Census microdata. Centralized matching of unemployed workers with vacancies may be considered as a proxy for social connections, in the close physical proximity afforded by urban living, in the functioning of urban labor markets.

Wasmer and Zenou (2006) and Zenou (2009a) provide an innovative bridge between urban economics and the DMP approach. The DMP approach to unemployment as well as all other aspects of changes in employment and labor force status has been particularly fruitful in understanding the spatial consequences of individuals' experiences through episodes of employment, underemployment, and out-of-the-labor force. The present paper emphasizes city specialization and intercity trade, while allowing for richness that is unmatched by other models, including how the prospect of unemployment affects urban structure under different settings for job matching. This paper is not the first to consider U.S. cities as subeconomies for the purpose of studying equilibrium unemployment. Some of the earlier contributions to the literature on macroeconomics with frictions address properties that the literature associates with effects of cities. As an example, Hall (1989) in discussing Blanchard and Diamond (1989), p. 61, wonders whether finding constant returns to scale for the matching function would imply that active, dense labor markets "generate the same flow of matches, per given combination of unemployment and vacancies as do lower-density, smaller markets."[3] More recently, Shimer (2007) studies the process of labor market adjustment when numbers of

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[1] A recent compilation using BEA data for GDP by MSA shows that even as growth in real GDP by metropolitan area slowed from 2.0 percent in 2007 to 0.8 percent in the first quarter of 2008, the distribution of growth in real GDP by metropolitan area varies from impressive growth in some areas, as in Grand Junction, CO at 12.3 per cent, to sharp decline, as in Kokomo, IN at 10 per cent.

[2] A key feature of Cuñat and Melitz (2012) is modeling flexibility versus rigidity in the context of international trade. Helpman and Itskhoki (2010) address questions broadly related to those of Cuñat and Melitz (2012), except that their models also allow for unemployment. That is, one of the two sectors in their model produces a final good by means of a range of differentiated products, which are themselves produced with raw labor and whose production is subject to market frictions, as modeled in the DMP fashion. Trade integration benefits both countries but may raise their rates of unemployment.

[3] Hall argues that such a finding should be taken to imply a much higher level of specialization in the large dense markets, or else there would be no efficiency benefits from large dense markets. If specialization were not omitted then a given combination of unemployment and vacancies would generate "moderate matching rates for highly specialized workers rather then very rapid matching for the less specialized workers and jobs. Hall's remark suggests the possibility that accounting for job market matching can be used to help distinguish between the different roles of city size in facilitating MAR externalities, matching and labor pooling.