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CHAPTER 1

Introduction

Economic activity in labor, goods and housing markets varies substantially over time. The number of unemployed workers, unfilled vacancies, unsold inventories, or houses for sale can easily double in the course of a few years. Similarly, at one moment finding a job or selling a house can take a couple of days, while at another moment either can take more than two years. Search frictions provide an explanation for the coexistence of unemployed workers and unfilled vacancies. Because search frictions result in trading delays, they can also help us understand time-on-market and how this can vary over time. Finally, search frictions make the occurrence of trade risky and dependent on the actions of others. The functioning of markets therefore relies on the strategies of all market participants, and the institutions that govern their interactions.

Indeed, markets with search frictions are generally characterized by externalities. When the optimal strategy of one agent increases in the strategies of others, strategic complementarities arise (Cooper and John, 1988). In such situations, agents have incentives to coordinate their actions and to behave in similar ways. In markets with search frictions, shifts in the coordination of the actions of economic agents can thus provide an explanation for the fluctuations in economic activity. This thesis studies strategic complementarities in labor, goods, and housing markets.

The seminal paper of Diamond (1982) is the first to show that search frictions can result in a coordination problem. In a model of a goods market, he shows that there exist different levels of economic activity that agents can coordinate on, if the probability that agents meet a trading partner is increasing in the number of potential trading

partners. Intuitively, when agents expect few potential trading partners to be around, they only pursue the few most profitable projects, and consequently only few trading partners will actually be around. Conversely, if many trading partners are expected to be available, many projects are worth to be carried out, and as a result there will actually be many trading partners. Studying the dynamics of this model, Diamond and Fudenberg (1989) show that it can generate self-fulfilling fluctuations in economic activity. If there are multiple markets with search frictions, the expected benefits of trade in one market can depend on the presence and behavior of trading partners in another market. Howitt and McAfee (1992) and Kaplan and Menzio (2016) show in related models with interactions between frictional labor and goods markets how exogenous shifts in expectations about the level of economic activity can be self-fulfilling and result in more irregular fluctuations.[1]

In Chapter 2 of this thesis, I apply a similar demand externality to explain the cyclical behavior of unemployment and vacancies. As a result of this externality, revenue per worker-firm match is increasing in aggregate employment.[2] The benefits of match formation in the labor market therefore depend on the actions of others in the labor market, because changes in aggregate employment affect the revenues that can be generated in the goods market. Expectations of higher future employment and thus higher revenue per match motivate current investments in matching, and are therefore self-fulfilling. For that reason, multiple perfect foresight equilibrium paths exist. Some of these paths never converge to a steady state, but to a stable limit cycle. Cycles exist because there is not only positive feedback, but also congestion. When employment is high and firms open many vacancies, it takes more time and resources to fill a single vacancy. These costs are no longer justified when firms foresee an end to the boom, and they cut back on recruiting. Employment starts to fall, together with revenue per match, until the labor market becomes so slack that hiring picks up again. The resulting limit cycle resembles the empirically observed counterclockwise

[1] Howitt and McAfee (1987) identify another reason why search frictions may result in multiple levels of economic activity. They point out that search frictions give rise to a bilateral monopoly across matched trading partners. As a result, any division of the surplus of a match is possible, and every division results in a different level of economic activity. Building on this insight, Farmer (2012) assigns a role to self-fulfilling expectations in selecting the level of economic activity. Kashiwagi (2014) applies this idea to the U.S. housing market. In this thesis, the division of the surplus is either determined by Nash bargaining, by a fixed price, or by competitive search. The results therefore do not rely on indeterminacy resulting from a bilateral monopoly.

[2] Alternatively, this relationship can result from increasing returns in production as in Mortensen (1999), or increasing returns in matching as in Diamond (1982).

cycles around the Beveridge curve - the negative relationship between unemployment and vacancies. I calibrate these 'Beveridge cycles' and show that both unemployment and vacancies are as persistent as the data, without losing any of the amplification of the standard search and matching model of Pissarides (1985). Persistence is the result of calibrating the cycle to the average duration of the business cycle, and does not rely on a (persistent) stochastic process. The fluctuations are generated by the interplay of the positive demand externality and the negative congestion externality, and this endogenous mechanism reduces the need for exogenous shocks in explaining fluctuations in unemployment and vacancies.

As is clear from the literature cited above, demand externalities or increasing returns to scale in matching are well-known sources of strategic complementarities. Chapter 3 of this thesis, which is joint work with Espen Moen and Plamen Nenov, shows that moving owner-occupiers in the housing market are impelled to coordinate their search behavior for another reason, not previously identified. Moving owner-occupiers must buy a new house and sell their current one. They can choose to buy first or to sell first, but search frictions result in costly delays for both buyers and sellers. Time-on-market depends on the ratio of buyers to sellers. When moving owner-occupiers would like to make the period in between the two transactions as short as possible, they want to conclude their second transaction as fast as possible after the first one, and therefore accept a longer time-on-market at their first transaction. If owners buy first, there will be more buyers than sellers in the market. Consequently, on average it will take long to find a suitable house, and buying first is optimal. Conversely, if owners sell first, the buyer-seller ratio is low. Houses are thus expected to be for sale for a long time, and selling first is optimal. As a result, there are two steady state equilibria: one in which everybody buys first, and another one in which everybody sells first.

The strategic complementarity above exists without an explicit role for prices. When prices are endogenous, resulting from Nash bargaining or competitive search, an additional strategic complementarity arises. Moving owner-occupiers who already bought first are relatively desperate to sell their old house, because of the costs of holding two houses. For that reason, they are willing to sell at a relatively low price. The possibility to exploit the impatience of such an owner of two houses increases other moving owner-occupiers' incentives to enter the market as a buyer. However, doing so implies that they buy first, also ending up with two houses. Similarly, any presence of impatient buyers motivates other moving owner-occupiers to sell first,

and to become desperate buyers themselves. Indeed, when trading partners come in different kinds, the composition of the pool of potential trading partners matters for the expected benefits of searching for a partner.[3] We also show that if moving owner-occupiers expect housing prices to rise, their incentives to buy first are stronger. Buying first implies that a household has a long position on housing in between the two transactions. Any anticipated rise in house prices thus makes it less costly to buy first irrespective of the buyer-seller ratio in the market. Conversely, a moving owner-occupier that sells first has a short position and benefits when prices fall. When prices increase in market tightness, expectations can therefore destabilize the housing market and lead to sudden self-fulfilling fluctuations in prices and market tightness. Such fluctuations are quantitatively relevant, as they could explain almost a doubling of the time-to-sell and price decreases up to 30 percent as the result of a switch from a 'buy first' to a 'sell first' equilibrium. The co-movements of these variables are in line with data for Copenhagen, a metropolitan area for which we can reconstruct the fraction of households that buy first.

In the data for Copenhagen, however, the fraction of households that buy first never reaches zero or one hundred percent, and the transition from this fraction's minimum to its maximum takes many years. For that reason, in Chapter 4 of this thesis, I build on the analysis in the previous chapter but relax the perfect coordination of moving owner-occupiers by assuming they neither know market tightness nor the fraction of households that buy first. Although the number of sellers can simply be observed from the stock of houses for sale, the number of buyers does not unambiguously show itself in the market. As a result, the crucial variable that determines optimal behavior - the ratio of buyers to sellers - is imperfectly observed. Instead, owners learn the behavior of others in a process of random contagion *à la* Lux (1995). If contagion is strong enough, multiple steady state equilibria exist with fractions of moving owner-occupiers that buy first unequal to zero or one hundred percent. However, housing prices are low when moving owner-occupiers in majority sell first. Such episodes offer profit opportunities to speculators that can buy houses cheap, rent them out, and bring them on the market later. Therefore I extend the model to allow for boundedly rational speculators that

[3] A similar strategic complementarity was first identified by Burdett and Coles (1998). They show that the expectation of a favorable composition can make matched agents separate from their current partner, to search for a better match. When such separation decisions actually improve the composition of the pool of potential trading partners, separation is actually beneficial to matched agents. In this thesis, separation is exogenous.

buy houses when they are cheap. When moving owner-occupiers take the presence of such speculators into account, the fraction of households that buy first can fluctuate perpetually in a way that closely matches the empirically observed housing cycle of Copenhagen, and presumably other local housing markets. The fraction of owners that buy first moves slowly, and in tandem with the number of transactions and housing prices, and in the opposite direction of the time-on-market and the stock of houses for sale.

The interaction between frictional goods and labor markets in Chapter 2 is of reduced form. Chapter 5, which is joint work with Piotr Denderski, features these markets explicitly in order to highlight unemployment risk in the labor market and the risk of not selling in the goods market. We propose a theory of the self-employment rate and the role of firms in the functioning of markets, which is based on the trade-off between these risks and the opportunities for insurance against them. Because both risks increase in the number of individuals facing them, their choices for self- or payroll employment are strategic substitutes. Equilibrium is therefore unique, and can feature the co-existence of self- and payroll employment. However, equilibrium is inefficient under risk-aversion. One reason for this, identified by Acemoglu and Shimer (1999), is that firms offer market insurance by paying lower wages, increasing the job finding probability. In our model, such market insurance additionally distorts the career choice in favor of payroll employment. We present an additional source of inefficiency, thus far not identified in the literature, which is driven by the ability of the self-employed to self-insure by setting lower prices. Because search is directed, lower prices increase the probability of selling. Despite a partial pricing response by firms, self-insurance steals business away from firms, distorting the allocation of buyers in the goods market. Consequently, firms' probabilities and benefits of trade in the goods market are smaller, and they decrease their investments in match formation in the labor market. As a result, unemployment risk increases and the career choice is distorted in favor of self-employment. Combining self- and market insurance results in a self-employment rate that is generally either too high or too low. We show that unemployment benefits and benefits for the self-employed that fail to sell, paid for by taxes that differ between self- and payroll employed, can target each of the margins of inefficiency and balance the budget. In the presence of search frictions, equity and efficiency may therefore move in the same direction, and there is a role for institutions to improve the functioning of markets.

This thesis shows once more that externalities are the norm, and not the exception, in markets with search frictions. Taking any resulting inefficiencies and positive feedback loops into account is crucial for a deeper understanding of recent developments in labor, goods and housing markets.