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Loss of skill and labor market fluctuations☆

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ABSTRACT

In this paper, we examine how skill loss can contribute to aggregate labor market fluctuations in the Diamond-Mortensen-Pissarides model. We develop a computationally tractable stochastic version of that model wherein workers accumulate skills on the job and face a risk of skill loss after job destruction. We find that skill heterogeneity dampens the fluctuations of labor market variables, and that introducing skill loss offsets this effect and generates additional amplification. The main forces driving this result are pro-cyclical increases in the probability of skill loss during unemployment: these provide incentives to post proportionally more vacancies during upturns by raising the surplus from employing high-skill workers. Compositional changes in the unemployment pool, on the other hand, play a negligible role for empirically plausible rates of skill depreciation, which imply a relatively slow process compared to the duration of unemployment spells.

1. Introduction

In its standard form, the Diamond-Mortensen-Pissarides model (henceforth DMP model) assumes random search, i.e. firms cannot direct their search to specific worker types and vice versa. A direct implication is that productive heterogeneity among unmatched workers matters for job creation. This relationship is in principle mediated by two channels. First, holding the distribution of productive heterogeneity constant over time, job creation should respond to differences in the surplus from employing low-skill vs. high-skill workers at different points of the business cycle. Second, holding the surplus from employing each worker type constant, job creation should respond to changes in the distribution of these workers over the business cycle. While these mechanisms are well understood in theory, their quantitative importance remains a topic of active research. The first reason for this is that productive heterogeneity depends on observed as well as unobserved characteristics of workers. As a result, it is difficult to measure its effects on the surplus from employment and how the distribution of worker heterogeneity changes over time. Another important issue is that models in which individual decisions depend on the evolving cross-sectional distribution of the economy are typically difficult to compute.[1] However, ideally one should use a rational expectation model with perfect foresight over this dynamics to assess the implications of productive heterogeneity for job creation.

In this paper, we investigate this issue in the context of a DMP model wherein workers accumulate skills on the job and face a risk of skill loss after job destruction. We focus on skill dynamics as a source of heterogeneity in light of the large literature that studies its impact on unemployment through, e.g., duration dependence due to skill depreciation (Machin and Manning, 1999; Layard et al., 2005) or the loss of specific human capital after job displacement (Pissarides, 1992; Rogerson, 2005; Wasmer, 2006). Specifically, the framework that we consider is a blend of the DMP model with aggregate shocks and the model put forward by Ljungqvist and Sargent (1998, 2008) to understand the high steady-state unemployment rates triggered by faster skill obsolescence.[2] We anchor this hybrid model to data on the returns to human capital accumulation and data on labor market transitions prompted by the loss of employment-specific skills. A parsimonious specification of the skill process enables us to compute the stochastic equilibrium while keeping track of the evolving cross-sectional distribution of the economy.

We establish, through a series of numerical experiments, the

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[1] This is the computational problem usually addressed by means of Krusell and Smith (1998)'s algorithm; see the 2010 special issue of the *Journal of Economic Dynamics and Control* for discussions of this topic.

[2] Ljungqvist and Sargent (1998, 2008) consider a McCall (1970) job-search model economy with skill accumulation and skill loss. Ljungqvist and Sargent (2007) develop a DMP version of that model. None of these models features aggregate shocks. So, the present paper is, to our best knowledge, the first to construct a stochastic DMP version of that model.

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following results:

(1) Skill heterogeneity dampens fluctuations in the DMP model. When workers accumulate skills and tend to retain these skills during unemployment, labor productivity is higher and therefore job creation is higher. Thus, on average labor-market tightness resides in the region with less curvature in the matching function, lowering fluctuations in the job-finding rate.
(2) Cyclical changes in skill loss offset this phenomenon and bring in additional amplification compared to an environment with homogeneous workers. These mechanisms are more pronounced if skills yield a large improvement in worker productivity and/or skills are time-consuming to acquire.
(3) Gradual skill loss, provided it moves pro-cyclically, increases the surplus from employing more productive workers during upturns. This is the main channel to amplify fluctuations in the model. Compositional changes in the unemployment pool, on the other hand, play a negligible role for empirically plausible values of the probabilities of skill loss: they imply a process of skill depreciation that remains slow relative to the duration of unemployment spells.

Quantitatively, we find that, compared to an environment with only skill accumulation, the addition of skill loss closes 20 to 45 percent of the distance between the model and data on labor market fluctuations. The amount of amplification depends on the mix between the risk of experiencing a sharp loss of skills, as in the event of job displacement (Jacobson et al., 1993; Davis and von Wachter, 2011), and the risk of losing skills gradually during unemployment (Machin and Manning, 1999; Edin and Gustavsson, 2008). The upper bound on the amplification delivered by the model, which we obtain if gradual skill loss is the only mechanism at work, hinges upon a reasonable value of the probability of skill loss: in the extreme scenario where the economy is stuck in the same aggregate state forever, a worker who remains continuously unemployed loses her accumulated skills after 'only' 16 months on average. Thus, an empirically plausible process of skill accumulation and skill loss can have substantial implications for the performance of the DMP model via the mechanisms (1)–(3) described above.

It is worth highlighting two features of the analysis to explain the results we obtain for a given set of parameter values.[3] First, in the implementation of the model, we consider two skill types (low-skill and high-skill), and we hold the distance between types constant in the experiments comparing, say, the model with only skill accumulation and the model with skill accumulation and skill loss. This magnifies the effects of skill loss because this process undoes completely the increase in productivity resulting from the time-consuming process of skill accumulation. With more skill types, the effects of skill loss on labor market fluctuations would likely be less pronounced.[4] Second, our model embodies a single matching function lumping together heterogeneous unemployed workers. As noted in the opening paragraph, this feature is standard in the DMP model (e.g. Albrecht, 2011), and is one of our motivations to focus on worker heterogeneity. If, on the other hand, low-skill and high-skill workers were assigned to different matching functions as in Ljungqvist and Sargent (2007), it seems likely that the cyclical response of vacancies would be qualitatively and quantitatively different.

The paper unfolds as follows. The rest of the introduction reviews the related literature. Section 2 presents the model. In Section 3, we select the parameter values of the model and outline our computational strategy. Section 4 contains the main results of the paper. Section 5 concludes. An online appendix provides computational and data details, and the results of several experiments summarized in Section 4.

1.1. Related literature

Numerous studies investigate ways to increase the volatility of labor market variables in the DMP model, following Shimer (2005) and Costain and Reiter (2008). There are mainly three avenues that are being pursued: changes in the wage setting rule, changes in the model's calibration, and changes in the model's specification. This paper falls into the latter category.[5] We assume wages are set via Nash bargaining throughout the analysis; we establish the results using standard parameter values and calibration targets, and we show that they are robust to changes in the calibration that are often investigated in the literature.

To relate the findings to studies that consider a DMP model with a richer specification, let us summarize as follows. The model with only skill accumulation and the model with skill accumulation, skill loss and no cyclicality in skill loss explain only 10 to 15 percent of the volatility of labor market variables. Adding cyclical changes in skill loss increases volatility by a factor ranging between 3 and 6, depending on the main process that leads to skill loss. There are studies exploring channels that yield the same amount of amplification. At the lower end, Silva and Toledo (2009) find that introducing training and separation costs in the DMP model amplifies fluctuations by a factor of 2 to 3; in a New Keynesian version of the model, Barnichon (2014) shows that adding variable labor effort yields an amplification factor of 3. At the other end of this spectrum, Bils et al. (2012) find an increase in the volatility of labor market variables by three quarters when the DMP model is modified to include *ex ante* heterogeneity in productivity and labor supply; Fujita and Ramey (2012) report an amplification factor of 6 in the model with endogenous job separation and no on-the-job search, and they show that on-the-job search closes the remainder of the distance to the data. So, compared to the mechanisms analyzed in these papers, skill loss has similar quantitative properties for improving the cyclical performance of the DMP model.

Within this literature, our analysis has parallels with Pries (2008); Bils et al. (2011) and Bils et al. (2012), who study worker heterogeneity as a means to amplify fluctuations in the stochastic DMP model. Pries (2008) considers *ex ante* heterogeneity in productivity and separation rates. He finds little amplification when the distribution of worker types remains constant, and a strong cyclical response of vacancies when compositional changes are introduced. Shifts in the composition of the pool of searching workers are exogenous in his model. Such shifts play a negligible role in our model because they are endogenous, and we find that these are very limited for empirically plausible values of skill accumulation and skill loss. Bils et al. (2011) report a result similar to ours, that worker heterogeneity can contribute to reducing fluctuations in the DMP model (cf. result (1) above). In their model, this reflects *ex post* heterogeneity in wealth. Our result may seem somewhat more surprising since we analyze productive heterogeneity. Bils et al. (2012) also use a model with differences in productivity as a source of heterogeneity. As already mentioned, they find that it delivers a non-trivial amount of volatility in labor market variables. This finding is due to the fact that productive heterogeneity in their analysis correlates with labor supply preferences, leading to the co-existence of low-surplus and high-surplus workers in the labor market. In our model, on the other hand, differences in the outside option of workers are driven by cyclical changes in the probability of losing accumulated skills. It seems likely that we would obtain larger fluctuations by allowing the flow value of nonemployment to co-move with these changes.

[3] We thank an anonymous referee for drawing our attention to the issues discussed in this paragraph.

[4] We consider two skill types in order to keep the computational task manageable. The number of state variables in the model increases quadratically with the number of skill types.

[5] Some influential studies that change the wage setting rule of the model include Shimer (2004); Hall (2005); Hall and Paul (2008) and Gertler and Trigari (2009). The paper by Hagedorn and Manovskii (2008) proposes a different calibration strategy of the DMP model that generates labor market fluctuations as large as in the data.