# Taxation and unemployment in models with heterogeneous workers [☆]

## Marcus Hagedorn [a], Iourii Manovskii [b,*], Sergiy Stetsenko [b]

[a] *University of Oslo, Department of Economics, Box 1095 Blindern, 0317 Oslo, Norway*
[b] *Department of Economics, University of Pennsylvania, 160 McNeil Building, 3718 Locust Walk, Philadelphia, PA 19104-6297, USA*

### A B S T R A C T

We introduce ex-ante heterogeneity between workers and two technology shocks, neutral and investment-specific, as the driving forces into the basic Mortensen–Pissarides search and matching model. The calibrated model is simultaneously consistent with a strong response of labor market variables to cyclical fluctuations in productivity and a weaker response to changes in taxes found in cross-country data. The model also matches the evidence that countries with higher tax rates have higher aggregate productivity, lower skill premia, and higher unemployment rates among both high- and low-skilled workers. The key mechanism that allows us to achieve these results is that aggregate and group-specific productivities are endogenous and respond to changes in tax policy.

© 2016 Elsevier Inc. All rights reserved.

## 1. Introduction

The facts describing the secular evolution of unemployment and taxes in the U.S. and continental Europe are well known. In the 1960s unemployment rates were quite similar in the U.S. and in the continental European countries. While the unemployment rate in the U.S. has remained at almost the same level at least until the Great Recession, the rates in many European countries have increased starting in the late 1970s and stayed considerably higher than in the U.S. since then. At the same time the tax wedge, measured as the sum of labor and sales taxes, has increased in those European countries relative to the U.S.

A natural framework to understand the relationship between taxes and unemployment is the leading theory of equilibrium unemployment, the Mortensen and Pissarides (MP) search and matching model. However, this simple framework has an important limitation for studying the effects of policies, such as taxation. Productivity is assumed to be exogenous so

* Corresponding author.
*E-mail addresses:* marcus.hagedorn07@gmail.com (M. Hagedorn), manovski@econ.upenn.edu (I. Manovskii), sergiy.stetsenko@gmail.com (S. Stetsenko).

that it does not respond to changes in tax rates. This seems restrictive both from an empirical and a theoretical perspective. Empirically, Prescott (2004), among others, documents that the increase in tax rates was accompanied by an increase in aggregate productivity (most notably in France and Germany) relative to productivity in the U.S. Furthermore, we document that the skill premium, the relative productivity of college and high school graduates, is strongly negatively related to the tax wedge.

Theory also suggests that large differences in policy do not leave productivity unaffected. In the theory developed in Krusell et al. (2000), changes in productivity are due to a technology which features capital–skill complementarity.[1] The adjustment of the stocks of capital as well as of high- and low-skilled labor in response to a change in policy leads to an endogenous change in productivity. This theory is a natural candidate to conduct a quantitative analysis with because changes in productivity can be accounted for by changes in observed factor quantities, most notably the stock of capital equipment. Thus, building on the standard MP setup we allow for ex-ante heterogeneity in skills (high-skilled and low-skilled workers) that interact on the production side of the economy as in Krusell et al. (2000).

The endogenous response of productivity in our model has several important implications. First, in the standard MP model, a one percentage point permanent decrease in productivity and a one percentage point permanent increase in sales taxes increase unemployment by the same amount. The finding that these two responses are very close is not a coincidence but a feature of many models driven by productivity, including the MP model. However, the data suggest that the elasticity with respect to productivity necessary to replicate business cycles is larger than the elasticity with respect to taxes required to explain cross-country differences (Costain and Reiter, 2008; Mortensen and Nagypal, 2007; Hornstein et al., 2005b).[2] Our framework can resolve this dilemma. The endogenous response of productivity mitigates the response to changes in tax policy without sacrificing the business cycle properties.

Second, Hornstein et al. (2005a) have pointed out that the MP model has the counterfactual implication that the rise in unemployment in response to, e.g., skill-biased technical change is concentrated among the low-skilled workers,[3] whereas Nickell and Bell (1996) and Gottschalk and Smeeding (1997), among others, conclude that data from many European countries support the conclusion that unemployment rose proportionately across the entire skill spectrum. We show that the change in productivities in our model induced by an increase in the tax wedge shifts the rise in unemployment toward high skilled workers.

We calibrate the model following the strategy of Hagedorn and Manovskii (2008a) and find that the two-skill version of the MP model is consistent with the cyclical volatility of the aggregate and group-specific labor market variables in the data. The model generates a high unemployment volatility among low-skilled workers because their productivity in the market is estimated to be relatively close to their productivity at home. The model also matches a high volatility of unemployment among high skilled workers despite the fact that their estimated value of non-market activity is substantially lower than their market productivity.[4]

To understand the cyclical behavior of labor market variables for different groups of workers it is essential to identify the cyclical behavior of their productivities.[5] The aggregate production function estimated by Krusell et al. (2000) provides the way to do so. This production function accounts exceptionally well for the trends in wages of skilled and unskilled workers over the last several decades. It thus appears to be a natural candidate to provide an accurate and parsimonious way to also measure the business-cycle properties of the marginal productivities of the two labor inputs it considers: high-skilled and low-skilled workers. Measuring the evolution of worker productivity using this production function, we find that the (endogenously determined) marginal product of high-skilled workers is considerably more volatile over the business cycle than the marginal product of low-skilled workers. One important reason for this finding is that Krusell et al. (2000) estimate that high-skilled workers and capital equipment are complements in the production process. Since investment-specific shocks are an important contributor to business cycle fluctuations (Fisher, 2006), they amplify the volatility of productivity of high-skilled workers. This explains why the cyclical volatility of unemployment is high for high-skilled workers despite them having a relatively low value of non-market activities. We also note that without capital–skill complementarities the effects of investment-specific shocks would be much smaller since they would not be focused on one group.

The paper is organized as follows. A discrete time stochastic version of the Pissarides (1985, 2000) search and matching model with two skill groups and capital–skill complementarity is laid out in Section 2. In Section 3 we develop our calibration strategy. In Section 4 we describe the quantitative behavior of the model over the business cycle, both in the aggregate and for both groups of workers. We find that the model matches the cyclical volatility of labor market variables very well.

---

[1] The literature on induced technical change, e.g., Acemoglu (2002, 2007) predicts a non-neutral shift in productivity in response to the change in relative abundance of productive inputs. If, for example, unemployed low-skilled labor becomes more abundant due to a change in the tax policy, technologies that are biased toward low-skilled labor and thus increase its productivity are more likely to be developed in the long run.

[2] For example, the MP model calibrated in Hagedorn and Manovskii (2008a) generates the observed amount of volatility of unemployment and vacancies but generates very large policy effects.

[3] See, for example, Mortensen and Pissarides (1999) and Albrecht and Vroman (2002) for alternative models that share this prediction.

[4] This is consistent with the common prior articulated in e.g., Mortensen and Pissarides (1999) who argue that it is a "plausible assumption that the economic value of non-employment (other than UI benefits) does not increase proportionally with skill." Moreover, they argue that the same is true of the UI benefits which are closer to the productivity level of less skilled workers.

[5] We cannot use wages to infer the cyclical behavior of productivity because wages are not equal to the marginal product of labor in a search model. In most parameterizations of the MP model, including the one in this paper, the level of wages is very close to average productivity. The cyclical properties of wages, however, are different from the cyclical properties of productivity.