

What Shifts the Beveridge Curve? Recruitment Effort and Financial Shocks

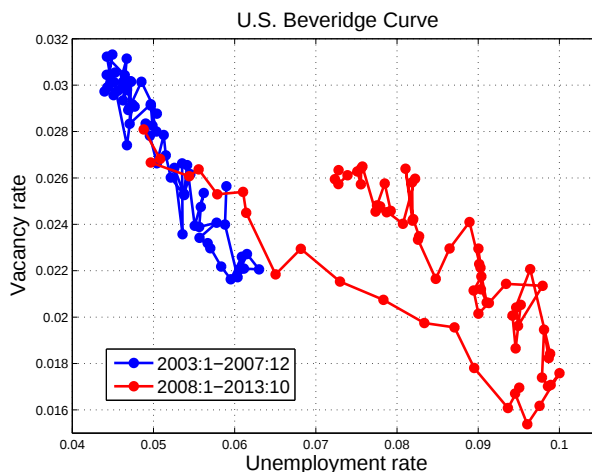
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Introduction

When compared to the early 2000's, the post financial crisis US labor market has produced a persistently higher unemployment rate relative to the level of vacancies posted by firms. Figure 1 shows the shift in this empirical relationship - the Beveridge Curve. In this paper we provide a quantitative general equilibrium model that explains one possible cause for this change and is consistent with a number of cross-sectional firm level facts that have as yet been unexplored in the literature. We posit a simple mechanism by which financial constraints reduce firm entry and growth of young firms. In good times these firms grow quickly and fill vacancies faster than older, slower growing firms. Vacancies posted following the recession are therefore filled more slowly, shifting the Beveridge curve outwards. This mechanism acts through (i) the time series change in the distribution of firms, (ii) the cross-sectional relationship between vacancy filling rates and firm growth rates, both of which we document empirically and replicate quantitatively.

Figure 1: US Beveridge Curve



Empirics

The empirical results that inspire our study are drawn from four sources. First, Davis *et al.* 2013 take establishment panel data on firm vacancies and hires from JOLTS and estimate a daily model of firm hiring. They find that, in the cross-section, the elasticity of the daily rate at which firms fill vacancies to the growth

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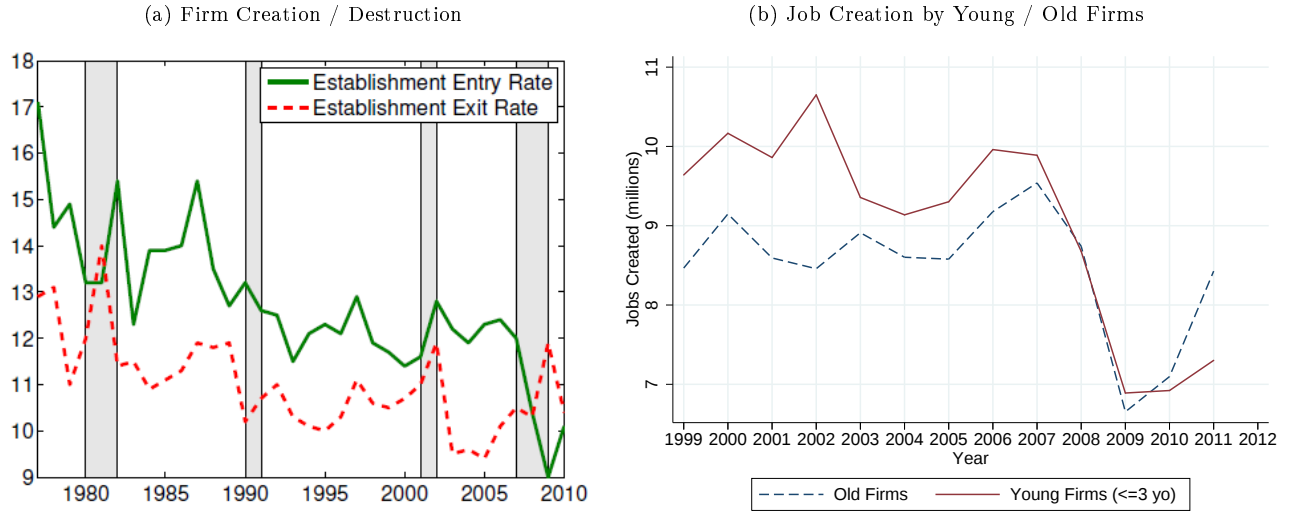
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rate of the firm is strongly positive - faster growing firms fill vacancies more quickly.¹ This is absent from search models of the labor market with random matching in which all firms fill vacancies at a constant rate given by aggregate market tightness. Second, Haltiwanger *et al.* 2012 use LBD firm level panel data to show that firm age is more important than size as a determinant of growth. Specifically, once firm age is accounted for, firm size loses its power in explaining firm growth rates. Third, compared to previous recessions BDS data show the Great Recession saw a more substantial decline in firm entry and a marked shift in the distribution of firms towards older firms (a fact documented extensively by Siemer (2013), see Figure 2a). Finally, BDS data shows that although the job creation rate of old firms has returned to pre-recession levels, the job-creation rate of young firms remains anemic.

We also contribute a separate empirical finding that links the observations in Davis *et al.* (2013) and Haltiwanger *et al.* (2012). Its important to our mechanism that firm age and vacancy filling rates are positively related. However the impossibility of matching establishment vacancy data from JOLTS with establishment age data from the LBD have made this impossible. Taking county level data on average establishment age and county level vacancy filling rates we show that this relationship does indeed hold at a low level of aggregation.

Figure 2: Firm and Job Creation



Quantitative model

Our modelling strategy provides a framework which can account for these facts while also matching standard labor market moments. We extend the firm dynamic heterogeneous firm model of Elsby and Michaels (2013) in which firms of different size and productivity hire workers by posting vacancies in a frictional labor market with random matching. Specifically, we add entry and exit, recruitment effort and financial constraints which are subject to aggregate shocks. The first of these features allows a role for age in the same style as Clementi and Palazzo (2010), allowing us to distinguish between young and old firms and allowing us to confront the facts in Haltiwanger *et al.* (2012). Second, we introduce a new technology through which costly recruitment effort by the firm increases the rate at which a firm's vacancies are filled. This is modelled specifically to replicate the cross-sectional relationship between vacancy filling rates and firm growth outlined above. The importance of modelling this margin has been noted by Diamond (2013) and Elsby *et al.* (2014) in their

¹Given the identity that firm hires h equal the fill-rate f times vacancies v , and that the growth rate g of the firm is equal to h/n , then the sum of the elasticity of the fill-rate with respect to growth $\varepsilon_{f,g}$ and the elasticity of the vacancy rate v/n with respect to growth $\varepsilon_{v/n,g}$ must equal one. In the standard model with f constant across firms $\varepsilon_{v/n,g} = 1$ and $\varepsilon_{f,g} = 0$, whereas Davis *et al.* (2013) estimate $\varepsilon_{v/n,g} = 0.18$ and $\varepsilon_{f,g} = 0.82$, suggesting that variation in the fill-rate is more important than variation in vacancy rates in explaining firm growth.

reviews of the Beveridge curve literature and to our knowledge we are the first to account for this systematic relationship in a heterogeneous job-filling rates in a model with random search.² Finally, financial constraints provide for a differential response of the economy in the great recession to previous downturns. As in Khan and Thomas (2011), we view previous recessions as due to aggregate TFP shocks and the most recent downturn as due to tightening financial constraints. This is consistent with the data. Common shocks to productivity lead to movements around the Beveridge curve, whilst tighter credit constraints most adversely effect young firms and potential entrants. As the distribution of posted vacancies shifts towards older firms with lower recruitment effort, aggregate match efficiency declines and the Beveridge curve shifts outwards.

The first question we consider is whether this mechanism can account quantitatively for the observed decline in match efficiency. We first calibrate our model. Following the approach of Elsby and Michaels (2013), we match steady state unemployment, labor market flows and features of the firm size and growth rate distribution to those found in the data. We identify the additional features of our model using data on firm entry and exit from the BDS, cross-sectional vacancy-filling rate data from JOLTS and the dynamics of labor market variables in the stochastic steady state of the model under TFP shocks. Examining the transition of the economy following an exogenous tightening in credit constraints, we find that as opposed to a TFP shock which leaves the firm distribution largely unaffected, a financial shock produces reduced entry and a shift in the distribution of firms towards larger, unconstrained firms. This is a similar result to that found in other heterogeneous agent models of the financial crises such as Khan and Thomas (2011) and Buera *et al.* (2013). An associated fall in firm recruitment effort leads to a drop in the aggregate filling job-filling rate in line with the data and fall in aggregate match efficiency of a little under a half of that implied by the outward shift in the empirical Beveridge curve. The model also matches the persistence of this shift. Given low returns to small firms, entry is discouraged. Meanwhile large firms with high productivity draws benefit from a slack labor market. As observed in the data the firm size and age distributions shifts to the right and takes a number of periods to return. Aggregate match efficiency inherits this persistence as larger slower growing firms prefer vacancies to recruitment effort in hiring.

Conclusion

This paper is the first to provide a quantitative equilibrium framework that accounts for a number of important facts associated with the ways in which firms hire workers. Once these facts are accounted for the age, size and productivity distribution of firms becomes an important determinant of aggregate match efficiency. Moreover, we are lead to a simple mechanism which accounts for a large amount of the persistent decline of match efficiency over the recent recession. Importantly, this mechanism abstracts from sources of worker heterogeneity which have been submitted by the mismatch literature as a cause for the shift in the Beveridge curve (see Wiczer (2013) , Valletta (2013) for examples and summary by Elsby *et al.* (2014)). In doing so it points policy towards subsidising the growth of young firms rather than the more daunting prospect of incentivising training (relocation) programs that align worker skills (geography) with those demanded by employers.

²The directed search model of Kaas and Kircher (2011) allows for this relationship qualitatively, however in their quantitative exercises find that the model is unable to generate the size of the elasticity of vacancy-filling rate to growth rate present in the data. More recent editions of their paper have sought to rectify this.

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