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On firm-level, industry-level, and aggregate employment fluctuations ☆

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ABSTRACT

Employment fluctuations are examined, at different levels of aggregation, in a model with firm-specific hiring decisions due to search frictions and sticky pricing. The results indicate that firm-level employment dispersion rises with higher price stickiness and higher demand elasticity, whereas it falls with more convexity of search costs and with a higher labor supply elasticity. Industry-level employment is more volatile and less procyclical than aggregate employment, and a larger industry size reduces volatility and raises co-movement with output. The calibrated model is able to match the volatility, autocorrelation and cyclical correlation of US industry-level employment when incorporating firm-specific technology shocks.

1. Introduction

Search frictions and unemployment have been recently introduced in dynamic macroeconomic models that assume homogeneous employment in the labor market (Walsh, 2005; Trigari, 2009; Blanchard and Galí, 2010). Such representative-agent models do not seem to be compatible with a search-and-matching theory of unemployment *a la* Mortensen and Pissarides (1994). Firm differentiation might be required to explain why workers become eventually fired while others are able to find a new job by filling a vacancy posting.[1] In other words, the endogenous determination of employment dynamics ought to be firm specific.

Hence, this paper describes a model with search frictions and unemployment that contemplates heterogeneous employment.[2] The key model ingredients are monopolistically competitive firms as in Dixit and Stiglitz (1977), sticky prices *a la* Calvo (1983), and a labor market with search frictions of the Mortensen–Pissarides style. Firm-level employment

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[1] Quoting Davis et al. (2007, p. 113): "Theories of unemployment based on search and matching frictions (Mortensen and Pissarides, 1999; Pissarides, 2000) rely on idiosyncratic shocks to drive job destruction and match dissolution."

[2] Other recent papers that describe a model with firm-specific employment are Sveen and Weinke (2009) and Thomas (2011). The model of this paper differs from these in the wage setting assumptions.

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dynamics can be determined as a combined response to price rigidities and search frictions when pricing and hiring decisions are connected at the optimizing program of the firm. In turn, firms differentiate in many dimensions: they have a specific selling price, they have a different number of employees, they offer a particular number of vacancies, they produce a different quantity of output, they organize different shifts of hours at work, and they pay a different nominal wage. Industry-level employment fluctuations are obtained as the average across the set of firms that belong to one industry. Finally, aggregate employment fluctuations are governed by a dynamic equation similar to the one derived in the models with search frictions and unemployment cited above.

The empirical evidence indicates that firm-level and industry-level fluctuations are more volatile than aggregate fluctuations (Comin and Philippon, 2005; Davis et al., 2007). Moreover, this volatility divergence has risen in the last few decades (Comin and Mulani, 2006).[3] This paper contributes to explain the determinants of higher employment volatility at disaggregated levels. In the calibrated model, employment dispersion across firms rises with the degree of price rigidity, and the elasticity of demand for consumption goods, and falls with an increase in the elasticity of the search cost function, and the elasticity of substitution in the labor supply. In model simulations with alternative industry sizes, business cycle statistics show an intense reduction of variability in the aggregation from firm-level employment to industry-level employment. This reduction is much higher with a larger industry size. The results of this paper also show that industry-level employment is more volatile and less procyclical than aggregate employment in both the calibrated model and US data.

However, the baseline model is not able to replicate the volatility gap because the standard deviation of industry-level employment is less than 10% higher than the standard deviation of aggregate employment, even in the case of a small industry size. Subsequently, the baseline model will be modified to incorporate firm-specific technology shocks as another source of firm heterogeneity. The simulation results will show that the calibrated model with idiosyncratic shocks is able to replicate the volatility, cyclical correlation and inertia observed in US industry-level employment fluctuations.

The rest of the paper contains four more sections. Section 2 describes the details and derivation of the baseline model and offers a calibration of its parameters. Section 3 examines the determinants of the volatility observed in firm-level employment fluctuations. Industry-level employment is defined in Section 4 and the effects of the industrial size on the second-moment statistics of employment fluctuations are examined in the baseline model and in one variant that incorporates firm-specific technology shocks. Section 5 reviews the main results.

2. A search-and-matching model with firm-specific employment

The supply-side of the economy is formed by monopolistically competitive firms of the type described in Dixit and Stiglitz (1977). Thus, firms may set a specific price while the amount of output produced is determined at the demand curve

$$y_t(i) = \left(\frac{P_t(i)}{P_t}\right)^{-\theta_p} y_t, \tag{1}$$

where $y_t(i)$ is output produced at the representative firm i, $P_t(i)/P_t$ is the ratio of price set by firm i over the aggregate price level, y_t is aggregate output, and $\theta_p > 0.0$ is a constant elasticity parameter. In their production technology, firms have two forms of varying labor input: at the extensive margin (number of workers employed, $n_t(i)$), and in the intensive margin (number of hours per worker demanded, $h_t^d(i)$). Assuming constant capital, and the same labor productivity in both margins, the production function of the i firm is

$$y_t(i) = (\exp(z_t) h_t^d(i) n_t(i))^{1-\alpha}, \tag{2}$$

where $0 < \alpha < 1$, and z_t denotes the economy-wide technology shock. After substituting (2) into (1), the demand constraint faced by the i-th firm is

$$(\exp(z_t) h_t^d(i) n_t(i))^{1-\alpha} = \left(\frac{P_t(i)}{P_t}\right)^{-\theta_p} y_t. \tag{3}$$

Wages are adjusted by the firm to equate total hours of labor supply and labor demand.[4] Hence, the nominal wage is the hourly rate that equates the willingness of workers to spend time at the firm (supply of total hours) with the need of work hours for the firm (demand for total hours).[5] For the specific i firm, the demand for total hours is obtained by turning (3)

[3] Using recent US data released by the Bureau of Labor Statistics, I report in the Appendix A that the standard deviation of industry-level employment in the US has been 38.7% higher than the one of fluctuations of total private employment.

[4] Alternatively, wages are defined in a Nash-style bargaining setup in many papers of the Mortensen–Pissarides literature (Walsh, 2005; Krause and Lubik, 2007; Christoffel and Kuester, 2008; Trigari, 2009).

[5] The impossibility of instantaneous hiring obliges the firm to modify the amount of hours per worker, $h_t^d(i)$, when output must be adjusted to meet current demand conditions. The other inputs of the production function (2) cannot be used to adjust the level of production because they are either exogenous (the technology shock, z_t) or predetermined (employment, $n_t(i)$).