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journal homepage: [www.elsevier.com/locate/jme](http://www.elsevier.com/locate/jme)Consumption heterogeneity, employment dynamics and macroeconomic co-movement<sup>☆</sup>Stefano Eusepi<sup>a,\*</sup>, Bruce Preston<sup>b</sup><sup>a</sup> Federal Reserve Bank of New York, 33 Liberty St, New York, NY 10045, USA<sup>b</sup> Monash University, 900 Dandenong Rd, Building H, Caulfield, VIC 3145, Australia

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## ABSTRACT

Real-business-cycle models rely on total factor productivity (TFP) shocks to explain the observed co-movement among consumption, investment and hours. However an emerging body of evidence identifies “investment shocks” as important drivers of business cycles. This paper shows that a neoclassical model consistent with observed heterogeneity in labor supply and consumption across employed and non-employed can generate co-movement in response non-TFP shocks. Estimation reveals fluctuations in the marginal efficiency of investment that explain the bulk of business-cycle variance in consumption, investment and hours. A corollary of the model's empirical success is the labor wedge that is not important at business-cycle frequencies.

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## 1. Introduction

A fundamental question in macro-economics concerns the origins of economic fluctuations. An emerging body of evidence suggests that disturbances to investment opportunities are fundamental drivers of business cycles. Fisher (2006) demonstrates that innovations in the relative price of investment are central to business cycles, while Gilchrist et al. (2009) and Gilchrist and Zakrajsek (2012) adduce evidence that movements in credit spreads and, in particular, excess bond premia, have statistically and economically significant implications for economic activity in the US.<sup>1</sup>

Embedding such sources of fluctuation in business-cycle models has been a challenge, a task first addressed by the seminal work. Standard neoclassical models of the kind proposed by Kydland and Prescott (1982) must rely on fluctuations in total factor productivity (TFP) to explain the observed co-movement among consumption, investment and hours worked — see Barro and King (1984). This presents a difficulty for many models of financial market dislocation often premised on strong intertemporal substitution motives<sup>2</sup> which predict under benchmark assumptions on preferences and technology, and constant TFP, that any change in consumption induces opposite movements in hours worked and investment.<sup>3</sup>

<sup>☆</sup> This paper was formerly distributed as “Labor Supply Heterogeneity and Macroeconomic Co-movement”.

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<sup>1</sup> Looking at financial variables during the 2007–09 crises, movement in these spreads is shown to be connected to changes in the supply of credit.

<sup>2</sup> See, for example, Carlstrom and Fuerst (1997) and Bernanke et al. (1999).

<sup>3</sup> As noted by Campbell (1994), the standard real-business-cycle model with TFP shocks also fails to deliver co-movement if the shock is more persistent than a random walk.

This paper offers three contributions. First, it presents a neoclassical stochastic growth model featuring heterogeneity in consumption of employed and non-employed that can deliver conditional co-movement in response to non-TFP disturbances. Second, using a calibrated version of the model consistent with micro-economic evidence from US households' consumption and labor supply decisions, conditional co-movement is generated for empirically plausible parameter values. Third, driven only by estimated shocks to the marginal efficiency of investment, the model explains a significant fraction of the US business cycle in output, investment, hours worked and *consumption*.

Two assumptions are made, motivated by empirical evidence for the US, in an otherwise standard real-business-cycle model. First, as predicted by theories of time allocation – for example [Becker \(1965\)](#) – and confirmed by empirical evidence, individual consumption expenditures are affected by the number of hours worked: the employed consume more than the non-employed in compensation for supplying labor. [Aguiar and Hurst \(2005\)](#) and [Aguiar et al. \(2013\)](#) demonstrate that households substitute between market and non-market work over the business cycle. And [Aguiar and Hurst \(2008\)](#) show that a large fraction of the drop in consumption expenditures at retirement can be explained by labor supply decisions. The resulting complementarities between consumption expenditures and hours worked are captured by non-separable preferences over these activities. Second, as widely documented, hours worked are adjusted for the most part on the extensive margin, which here is modeled as costly labor market participation.

Together these assumptions imply co-movement over the business cycle through a composition effect engendered by heterogeneity in the consumption behavior of employed and non-employed workers. All else equal, any increase in employment directly raises aggregate consumption, above and beyond the response of individual consumption. Consider an exogenous improvement in the marginal efficiency of investment. A higher marginal value of wealth leads to higher investment, with the required resources provided by higher employment and hours worked, as well as an initially muted but gradual increase in consumption of both the employed and the non-employed. However, the compositional effect arising from the higher numbers of employed generates a significant expansion in aggregate consumption. This is the key ingredient allowing the model to produce strong co-movement among consumption, investment and hours worked and, in particular, permitting shocks to the marginal efficiency of investment to explain a significant part of business cycles in consumption.

In a simplified version of our model, analytical results show co-movement hinges on the magnitude of the consumption differential between the employed and non-employed and the relative importance of the intensive and extensive margins of labor supply. Our baseline model specification includes common additions to the real-business-cycle framework, such as variable capacity utilization, habit formation and investment-adjustment costs. These enhancements are, either individually or in combination, shown to weaken the requirements for co-movement and to improve the model fit, but are by no means necessary for delivering co-movement. In all cases heterogeneity together with hours variation on the extensive margin is necessary for co-movement. A representative-agent model with non-separability in consumption and leisure cannot generate co-movement without violating concavity of the utility function or the assumption of normality of consumption – see [Bilbiie \(2009\)](#). And under complete financial markets, models with heterogeneous employment decisions and separable preferences, such as [Rogerson \(1988\)](#), imply that consumption is equalized across agents so that variations in employment do not produce composition effects on aggregate consumption.

In this context, the paper evaluates the importance of disturbances to the marginal efficiency of investment for business fluctuations in post-war US data and their consequences for macro-economic co-movement. While we are by no means the first to explore these issues, the contribution is to establish the importance of such shocks for consumption dynamics. Most parameters are calibrated to match evidence from micro-economic data. Focus is given to the non-separability between consumption expenditures and hours worked, which is shown to be in large part determined by the average consumption difference between employed and non-employed. Using evidence from available literature – [Aguiar and Hurst \(2005, 2008\)](#) – and estimation exercises based on data from the Consumer Expenditure Survey gives an estimate of a 23% consumption differential. Regarding our second assumption, to capture the dominant role of employment changes in explaining fluctuations in aggregate hours it is assumed that the elasticity of individual hours worked to the real wage is one-third of the elasticity of employment: this implies a volatility of employment relative to total hours worked of roughly 80%, consistent with US data as measured by the BLS establishment survey covering the non-farm private business sector.

The model attributes economic fluctuations to four exogenous processes: government purchases, neutral technology, labor taxes and the marginal efficiency of investment. These processes are estimated using maximum likelihood with data on total hours, consumption, output and investment. Making assumptions sufficient to identify innovations to the marginal efficiency of investment, the results that reveal a substantial fraction of business-cycle variation are accounted for by these shocks – over 80 percent of variance in investment, hours and output, and roughly 50% of consumption – *holding government spending, TFP growth and labor taxes constant*.<sup>4</sup> Importantly, the model generates positive co-movement between all four variables in response to an innovation in the marginal efficiency of investment. This is not merely a statement about the impact effect of such disturbances but rather a stronger statement about the properties of business cycles as evidenced by the variance decompositions. Our model provides a better fit to the data compared to both our benchmark model with separable preferences over consumption expenditures and market hours worked and also the real-business-cycle model,

<sup>4</sup> This is a property of our identification procedure. No 'spillovers' to from the investment disturbances to other disturbances are permitted, in contrast to [Christiano and Davis \(2006\)](#).

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