Spatial Meritocracy Revisited: Efficiency Wages and Oligopoly Reaction Functions with House Price Fluctuations

By Alfred A. Mayaki[1]

Abstract

In this paper, the author demonstrates a theoretical model with New Keynesian microfoundations based on a dynamic *spatial* class of general equilibrium. The author outlines a notation for the intuition of the efficiency wage, nominal house prices, with oligopoly reaction functions. The paper then concludes by identifying new areas for further research that may be feasible with longitudinal or census data, stamp duty data, data on average hourly earnings, and data on the retail price index.

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1. Intoduction

2. The Model

Standard efficiency wage models of unemployment have concerned many an Economist in the literature, going as far back as Shapiro and Stiglitz (1984), Yellen (1984) and Summers (1988). As with Yellen (1984) I have previously demonstrated how in periods of relatively high inflation or i, the balanced growth in the aggregate real wage w and the incremental *period-on-period* increases in the equilibrium market entry price condition p are incompatible effects (Mayaki, 2015). We know this because demand for labour reduces under inflation pressures. This is where dynamic wage pressures arise. Mitchell and Juniper (2007) note in their paper that there are disparate labour market outcomes in regions of an economy with skill imbalances. This following set of equations explain why in a standard efficiency wage and bargaining scenario, firms must contend with a strategy of maintaining dynamically stable downstream prices or undercutting the equilibrium to retain efficient workers (Strand, 2003). The system of equations that represents this identity is thus given by:

(2.1) $f(x) = (w, p, q, k)$ where k is the firm's arbitrary cost function

(2.2) $\therefore$ we arrive at: $= \alpha_t + \sigma(p_t q_t - k_t) - w_t + \varepsilon_t$

The optimal relation between oligopoly firms in the model assumes the constant α and the non-integer coefficient "σ" comprise what we can refer to as the Stakleberg firm's pre-entry profit function at time t (Friedman, 1979). I assume a pre-entry game with asymmetric information to be true and that each firm makes its price setting decision simultaneously (Robson, 1990).

(2.3) $$= \alpha_t + \sigma(p_t q_t - k_t) - w_t + \varepsilon_t$$

Where α_t represents the an initial constant value. The residual value ε represents the non-time dependent error term. The partial differentials with respect to p and q at time t define the oligopoly firm's maximum profit during the pre-entry game, expressed as a function of the Stakleberg firm's pre-entry profit maximising output level $q(t)$:

(2.4) $$q_t = k_t + w_t - \alpha_t - \varepsilon_t$$

Proof: In (2.4) the function derive the intuition from (1.14) as found in Mayaki (2015). That is to say, the slope of k, necessitates the follower firm's output q to be a function

decreasing with respect to its value of w. We make derive this identity as in Varian (1992) in regard to sequential games of quantity leadership. The real wage faced by the follower firm is thus given by (2.5)

(2.5) $$w_t = q_t - k_t \quad \text{for all} \quad q = 1, 2 \dots Q$$

In the above expression, for the skilled worker, implies the output level is decreasing in the firm's cost function. The concept of a Nash equilibrium bargaining solution for the efficiency wage is dependent on two important factors. The first is that w and k must equal 1 and the second is that q must be have stable values representing capital c and total factor productivity v for all values of q whereby $Q = q_1, q_2 \dots Q_N$. We already know that Walrasian general equilibrium conditions imply that: $Y = Q_1, Q_2 \dots Y_N$.

3. The Model with Interest Rates

In the literature, the concept of the dynamic *spatial* general equilibrium has explored this relationship (Krugman, 1992). Building a DSGE model with microfoundations may imply certain assumptions to hold that are necessary for the general equilibrium to be binding across locations in a spatial model, for example, agent preferences against leisure and work. Briefly, consider the nominal interest rate target based on the monetary policy rule in the work of Gavin, *et.al.* (2012):

(3.1) $$r = r^* + 0.5(Y - \overline{Y}) + 0.5(i - \bar{i}) + 2$$

Where output Y (which itself is the target level of output or gross domestic product and the very same target level of ouput we use in the estimation for the interest rate r) is derived from a function of aggregate level total factor productivity multiplied by capital + labour. Note: A small sorority of practitioners have studied the effect of productivity on the equilibrium interest rate with empirical findings that demonstrate how productivity growth has slowed since around 2004 (Lundsford, 2017; Yi and Zhang, 2017). The dynamic stability of the aggregate variable for labour is derived from the balanced growth path of a set of expressions that represent firm worker Pareto-efficient payoffs for shirking, effort, leisure, welfare and of course.

If we then assume the output gap evolves around the functional form of total factor productivity (Beckworth and Hendrickson, 2019; David and Zeke, 2021) with the Cobb-Douglas exponents, whereby:

What are the main policy determinants of the UK real interest rate at the dynamic *spatial* general equilibrium, as per Krugman (1992)? The objective of this paper is to

demonstrate that the central bank's real interest rate[2], r is seen as a function of the change in output [which itself is a function of total factor productivity growth and the rising capital stock[3]] and the change in inflation. Furthermore, I refer to the existence of a velocity and *digitalised* velocity (Campajola *et. al.*, 2022) which transcends much of the published literature on physical time velocity (Benk and Gillman, 2009; Jafarey and Masters, 2003). I highlight the existence of a spatial plane which determines this velocity. It is this spatial characteristic that indemnifies the interest rate's potency.

That is, the smaller the vicinity within which the central bank's money supply circulates, the more accelerated the economy's inflationary pressure. As we now know, the measured contraction in the gross domestic product level may take hold as a result of a material but incremental increase in the interest rate to 'balance' the economic effects of increases in the rate of inflation. This is not necessarily detrimental, so to speak, to the time velocity or micro-velocity (Campajola *et. at.*, 2022) as this empirical observation is indirect[4], and the variable may very well have increased to a new equilibrium. The following graphs illustrate just how delicate the central bank's concerns are. Some in the literature on the art of curbing inflation have pointed the fact that the focus of policy is almost dead set on curbing the rise of a variable that is unnaturally exponential in its characteristic, that is to say, inflation.

In my discussions with David Blanchflower of Dartmouth College I have mentioned repeatedly the relevance of time velocity of money as a cause behind increases in the future rate of inflation. Blanchflower's response was to redirect me to th U.S. data. Campajola *et. al.* (2022) has already found evidence to suggest that the spatial distribution of wealth with assets such as Bitcoin is "extremely unequal across active wallets", according to the Gini-coefficient used in the model. So, why are myself and David Blanchflower so concerned with time velocity and the potential for negative output growth you ask? One answer I can provide is because of cryptocurrencies which are characterised by micro-velocity which still represent an opportunity cost. Now, as we know, money itself generally circulates at a circulation speed that has no direct relationship with the output gap. What this implies is that other factors control for its velocity, such as the size of an economy or the level of its long run equlibrium, as in the *P* Model* with stable deposit rates (Orphanides and Porter, 1998). What does the data tell us? Well, a Masters thesis on this topic has recently evaluated the role of digital payments to China's economy (Chen, 2021). The author here finds evidence that payment methods such as digital value cards and other digital e-money types is correlated negatively with a estimated variable referred to as '*opportunity cost*'. Chen (2021) makes six valuable policy recommendations for controling micro-velocity but moreso for regulating the issuers of e-money. These recommendations are very insightful as to the

[2] Also referred to empirically as the equilibrium real interest rate
[3] Particularly true in service where QA is part of the productivity equation (Langford, et.al., 2000)
[4] I note that there is no evidentially direct relationship between the interest rate and money velocity.

proactivity with which the Chinese approach systemic risk and contagion in its financial markets.

4. Theory of Spatial Meritocracy

This paper revisits the concept of 'spatial meritocracy'. But you may be asking, what purpose does it have in the discussion on the topic of general equilibrium? Surely, dynamic general equilibrium and spatial merit are two contextually distinct concerns? One is largely concerned with monetary economics and the other to a greater extent with the field of urban geography and civil engineering. Spatial meritocracy emerges from spatial justice and the two are both layered and interdisciplinary in their nature, so much so that it creates a transfusion of operative domain knowledge, and commands th requisition of a relevant skillset from any researcher competent enough to uncover its value. Furthermore, let us not forget the importance of spatial econometrics in deriving the fundamental and provoking outcomes that research in spatial justice is so consistently built upon. Spatial meritocracy is focused on embracing these outcomes, and focusing them/channeling them into equitable policy decisions. It's not a widely used or prolific term. I believe I am one of the first to have ever used it in the literature. The only other literal use of the term was by Averett University Professor, Jeremy Groskopf, in his critically-acclaimed non-fiction book on the recent history of American advertising. In his book, entitled "*Profit Margins*", Groskopf explains:

> "*Beyond cost concerns, questions of reliability of the audience were as noteworthy for peripheral advertising as they were for all other methods. Indeed, questions of reliability took on much heavier importance with the breakdown of assumptions of receptivity. It is noteworthy that the above claims about being bored by the films were made by frame designers who, despite arguing for a spatial meritocracy, remained pessimistic about advertising's ability to draw attention on its own merits. As numerous inventors implied, the advertising needed, at the very least, to be associated with the main screen in order to be considered viable; as such the positioning of the technology, even if the screen was off-limits, still implied that the audience needed to be nearly, if not entirely, forced to read advertising.*" pp. 215 (Groskopf, 2021)

I felt it was somewhat necessary to reach out to Jeremy Groskopf fo the sake of reconciling some of our differences. When prompted for a definition for this complex term, the author and Ph.D. instructor, Groskopf, was more than available to provide one, stating explicitly and in no uncertain terms in an e-mail reply to a question I asked about complexity. He writes: "In the context of that section of the book, a 'spatial meritocracy' would apply to any venue where the film was forced to directly compete for attention

with advertisements nearby on the walls. People who made and sold early theatrical advertising technology liked to think of advertising as something that could be just as appealing to a viewer as anything else".

Groskopf continues: "So, if advertisements were allowed to be placed right next to the film screen, then - they argued - the most interesting item would win the attention of the audience. (This is effectively the same reason why advertisers like to have their ads on the same page as content in a magazine, rather than collecting all ads into an advertising section. This allows the ads to compete with the content head-to-head, rather than being relegated to a separate location)". This is all somewhat utopian, of course. The film would always have been placed in the centre, with the ads slightly off to the side. And an unchanging advertisement in a movie theater would likely become less interesting the longer it was available. But anyone arguing that audience attention would be given to the most deserving item in view was making a sales pitch. So we shouldn't be too surprised by over-the-top assertions." (Groskopf, 2021). Groskopf may be right here, but I contend with Groskopf's view concerning the value judgement of the movie theatre. If one takes the economics of advertising as an example, its is possible to uncover the concept of *cumulative* rather than *momentary* advertising (Friedman, 1983:464). Spatial meritocracy is thus not altogether effectual to the concerns of theatre advertising.

5. Non-Parametric Uses of Spatial Meritocracy

The following subsection of this paper will answer a few important questions. In agreement to Groskopf (2021) this paper perceives spatial meritocracy to be necessarily based on the successes of applied spatial econometrics, which is a relatively new field of economic design and modelling that allows for Economists to add and propose model features with a certain level of geographical intuition. However, having explored these settings with multidimensional variables and in panel form (as opposed to more granular data) in the context of the efficiency wage (Mayaki, 2023) which can be estimated around the interest rate, I will only explore the hypothetical annotations of this particular model. Applied spatial econometrics is covered in Kopczewska (2021) where the author in Chapter 5 explains the relevance of a number of key features of the econometric field, including spatial dependence and autocorrelation, with the eventual objective of deriving spatially robust results from estimated datasets.

$$Y = AK^{\alpha}L^{\beta} \text{ where } \alpha + \beta = 1$$

This is what distinguishes spatial and stochastic models of this form, i.e. dynamic and *spatial*? The dynamic *spatial* class of models (Kleinman *et. al.*, 2023) are distinct from their dynamic and *stochastic* siblings in that the onus is on spatial equilibrium at steady state rather than equilibrium across all markets (for instance, as in an RBC or New Keynesian economy) with optimal New Keynesian microfoundations (Mehrling, 2009).

What problems does the *spatial* DSGE attempt to explain? The spatial DSGE attempts to explain the significant skills mismatches (Sun, *et.al.*, 2023) - DSGE with skill and firm heterogeneity which according to this paper, mentions the observation that mismatches in skill do not lead to *significant* income disparities

What perspective do dynamic *spatial* models bring to the discussion on spatial justice and meritocracy? Much of the literature on spatial models (Brakman, et. al., 2004) are not DSGE but we nevertheless encounter issues such as disparate wage outcomes (Combes, et. al., 2008) where he literature acknowledges that a polarised distribution exists where clustering of poverty (Ross and Znou, 2008) and unemployment are demonstrable empirically in most metropolitan cities in the US and Europe (Dorn and Zweimüller, 2021) and also most other Emerging Economies (Jeguirim, 2021). These cities are characterised by a concentration of unskilled labour supply and low wages in specific regions of their central cities and inner ring suburbs (Ross and Zenou, 2008).

What variables are important to a DSGE model? Krugman (1992) notates a detailed "centripetal" and "centrifugal" geographical model. In his paper on spatial equilibrium, Krugman then includes expressions which explain these effects with respect to wages. If we consider a simple dynamic *spatial* general equilibrium model where there are N heterogenous agents, and g oligopoly firms, each agent N earns an optimal wage w, based on preferences over leisure[5] and such that a budget constraint on consumption determines consumption of permanent income. The worker efficiency wage w^* is an expressed as a function of the oligopoly firm's profit function, we derive the following expression:

$$f(\pi) = m + \delta(g, N, p, q) - w + \varepsilon \text{ s.t. } p \geq 1 \text{ and } i = \bar{x}$$

Where m is an intercept term representing initial wealth, changes in the medium-term stability p are determined by exogenous factors such as inflation i. Spatial dependence is given by the state variable δ, spatially autocorrelated residuals are given by ε and firm output decisions q in a specific city location, at any point in time t.

[5] Taking productivity as given by the level of aggregate technological progress. When wages are optimal, time spent on leisure is minimised, for the rational agent with strict preference not to shirk there are consumption smoothing effects I describe in Mayaki (2023).

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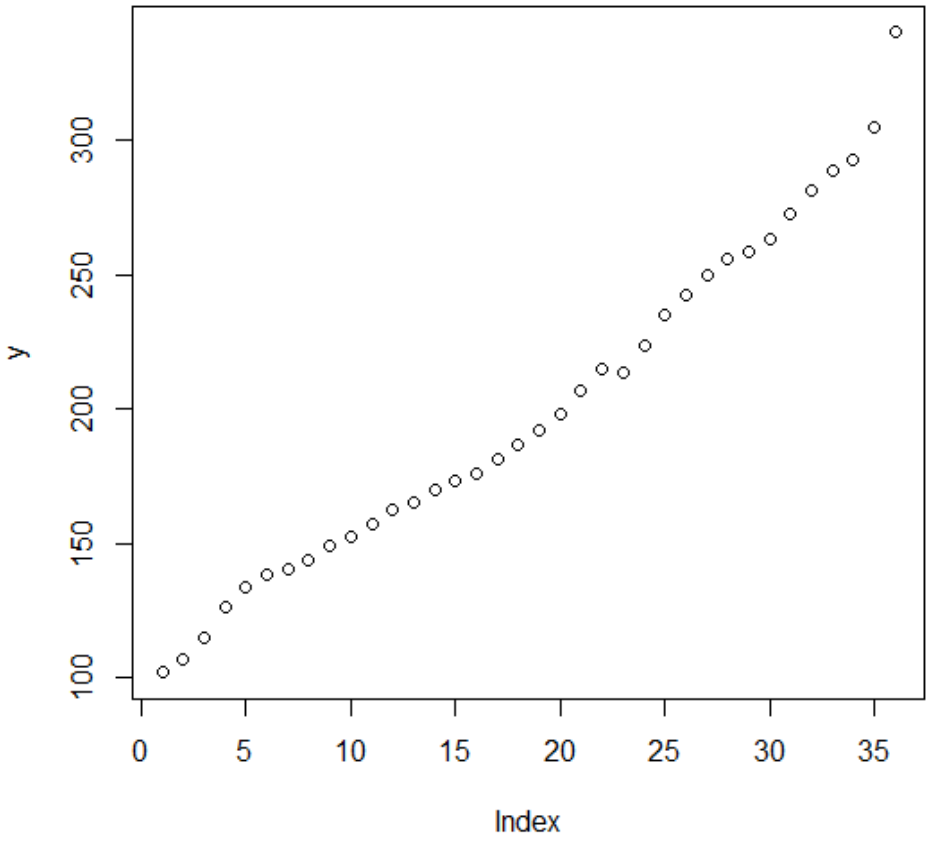
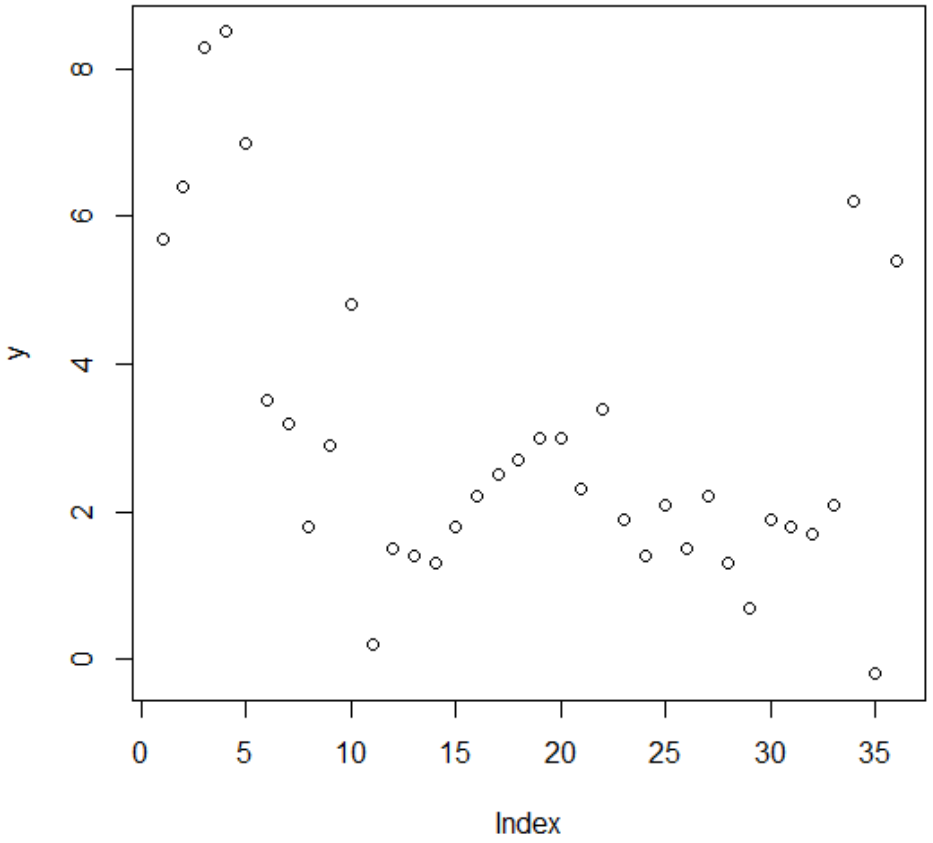
7. Appendix

Fig 1 - UK RPI[6] rebased to 100 (1987 to 2023)



[6] The UK Retail Price Index (RPI) is a backward-looking indicator of the aggregate price-level, which unlike the CPI, excludes mortgage repayments.

Fig 2 - UK GDP Output Growth - Deflator (1987 to 2023)



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