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Reference dependent preferences and labor supply in historical perspective

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ABSTRACT

To evaluate voluntary labor supply decisions under transitory monthly piece-rate schedules, we draw from a novel dataset on workers who originated from self-sufficient farms in New Hampshire, Vermont, and Massachusetts, and were recruited into textile mills in eastern Massachusetts in the early 19th century. Where life-cycle models of labor supply predict a positive relationship between labor supply and transitory changes in wages, we instead find negative wage-labor supply elasticities consistent with reference-dependent income targeting. Our findings contribute to the contemporary debate over the empirical validity of competing labor supply models. They also bring into question common modeling conventions in economic history that are used in the construction of historical narratives.

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1. Introduction

1.1. Background

The elasticity of labor supply is fundamental to a wide range of issues. Its estimate can lead to different interpretations of voluntary and involuntary unemployment (Fehr and Goette, 2007) and the degree of competition in the labor market (Staiger, 2010). It is also central to the theoretical design and implementation of tax and transfer systems (Meghir and Phillips, 2008) as well as real business cycle models of the macroeconomy (Prescott, 2004). While the study of labor supply decisions is a traditional topic of study for labor economists, it is as open and contested now as it has ever been. The issue that has arguably caught the most attention among scholars in the recent literature is how workers intertemporally substitute labor for leisure under transitory wages.

In the conventional life-cycle framework, workers seek to maximize lifetime utility by trading leisure for work in periods when the marginal utility of leisure time exceeds the discounted period wage rate. Under transitory wages, the substitution effect is always positive and is greater than the income effect, so that increases in the wage rate lead to greater labor supply, as workers substitute work for leisure given work's increased opportunity cost. When wages decline over the lifecycle, workers allocate more time to

leisure. In contrast, the theory of labor supply built on prospect theory and gain-loss aversion suggests that individuals establish a reference point for income in a given time frame (say, a day, week, or month) and adjust their labor supply around that point. Thus the income effect is larger in magnitude than the substitution effect around the target income level, meaning that workers around the target will reduce their labor supply when the wage increases and increase their labor supply when the wage decreases. For unusually high or low wages, the labor supply elasticity is still positive.

More recently, the prospect theory of labor supply has been extended by Farber (2005, 2008) and Köszegi and Rabin (2008). The former framed the labor supply decision as a stopping problem depending on accumulated earnings within a particular time frame, such as a day. The latter proposed a theory of reference-dependent behavior wherein *expected* income affects labor supply. Thus, when a worker expects her wage to be high, she will work long hours as the neoclassical theory predicts. But when her actual or realized wage is higher than she expected, she will work less hours.

Turning to the empirical literature, the evaluation of labor supply under transitory changes presents considerable challenges. The lack of an environment in which to study the issue has steered researchers toward seeking out novel micro datasets (e.g., Camerer, 1997) or controlled experiments (Fehr and Goette, 2007). The empirical record reporting measures of wage elasticities ends up painting a rather checkered picture. Some studies that use an aggregated measure of annual hours to represent labor supply report weak positive wage elasticities (MacCurdy, 1981; Altonji, 1986).

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Other papers that followed the work of [Camerer \(1997\)](#) have found, to the contrary, positive wage elasticities (e.g., [Oettinger, 1999](#); [Imai and Keane, 2004](#); [Stafford, 2015](#); [Farber, 2015](#)), including recent studies of the popular ride-sharing company Uber ([Chen and Sheldon, 2015](#); [Sheldon, 2016](#)), while others report insignificant or negative wage elasticities (e.g., [Goette, 2004](#); [Nguyen, 2011](#); [Abeler, 2011](#); [Crawford and Meng, 2011](#); [Eggert and Kahui, 2013](#); [Agarwal, 2013](#); [Dupas, 2013](#); [Leah-Martin, 2016](#)).

1.2. Overview of results

Our paper makes a contribution to this literature because it is based on a novel data set in which wages are transitory and applied to all workers. Workers face few restrictions on their labor supply decisions and the work task varies little if at all between workers. Transitory wages also have little impact on wealth, ruling out the possibility of a negative impact on labor supply due to wealth effects. The data are drawn from the Lawrence #2 textile mill in Massachusetts during a 20-year period beginning in the mid-1830s. Claudia Goldin once noted that “History serves economics in various ways.... The past, many economic theorists have discovered, is a giant experiment station for economic ideas. And empiricists have discovered that historical data are often better (for example, because of less litigious environments) and provide larger samples (that is, longer time series)” ([Goldin, 1995](#), 191). It is in the spirit of her argument that we conduct a straightforward test of the life-cycle and prospect theories of labor supply.¹

We find a negative labor supply elasticity consistent with the predictions of the prospect theory of labor supply. Our empirical strategy includes worker fixed-effects and controls for worker tenure at the firm, capacity utilization, and supervisory intensity. Responding to earlier criticisms of the relevance of the model for workers of different skill levels, we find that the negative elasticity result holds across all groups of workers: more experienced workers behave no differently from the estimates derived using the entire dataset. Our dataset also allows us to test for effort targeting and to include more specific estimates of gain-loss aversion. We find that worker effort responds less strongly to losses than to gains. Our study makes an additional contribution to the appropriate use of modeling techniques when constructing narratives in economic history.

2. Data

2.1. Advantages over previous work

We use monthly worker-level data from the upper-level weaving room of the Lawrence #2 textile mill in Lowell, Massachusetts. Variables included in our study are: output, days worked in a given month (which were recorded by the mill owners), productivity (measured as pieces woven per worker hour), piece rate (the same for all workers in a given month and variable between months), worker tenure/experience (measured as cumulative days worked at the mill). Data cover the period between 1834 and 1855 with two years missing – 1836 to 1838 – when the mill shut down. The number of workers observed per month varies, so that in the

end we have over 13,000 observations for the 20-year period. The workers were young women mainly recruited from New Hampshire, Vermont, and other parts of rural New England, though the composition of the workforce began to change in the mid-1840s with the influx of Irish immigrants ([Dublin, 1981](#); [Lazonick and Brush, 1985](#)). After arriving at the mill towns they stayed in boarding houses, the fees for which were paid out of their wages. In short, we study a relatively homogeneous workforce that received the same wage while performing a task that required some limited skill – an advantage over previous studies where wages may have been different per individual (most studies of labor supply in the vein of [Camerer \(1997\)](#) have studied self-employed workers) or where the workforce was potentially more heterogeneous.

The decision-making time frame in many empirical studies of labor supply decisions, such as taxi drivers ([Camerer, 1997](#)), baseball stadium vendors ([Oettinger, 1999](#)), and fishermen ([Eggert and Kahui, 2013](#)), is daily. For our paper, the measured piece rate is constant over the entire month. This fact makes the modeling strategy more straightforward and gives us a clearer test of the labor-leisure tradeoff, since uncertainty about future compensation parameters within the income target’s window of time is removed from consideration. Workers knew what their wage would be for the entire month and could reliably determine how much they would work and make (see below for evidence on voluntary labor supply). When there were changes to the piece rate, they were announced ahead of time to all workers and were effective at the beginning of the following month ([Dublin, 1981](#)).

Transitory wage changes (an additional advantage of our dataset) insulate against potential wealth effects that can confound our elasticity estimates. While there are advantages to the kind of “shocks” employed by [Treble \(2001, 2003\)](#), such as meeting the need to focus on exogenous changes in the wage that are not correlated with labor supply, transitory wage changes have the advantage of being much smaller. Shocks could induce the income effect to dominate the substitution effect. In this way, then, transitory wage changes can help address wage exogeneity concerns (see next section) while also maintaining a reasonable limit on the range of changes in the wage.

2.2. The environment at the mill

The nature of wage changes is crucial to our analysis. Our measure of the wage, the piece rate, is the same measure used by [Lazonick and Brush \(1985\)](#) in their study of the effects of changes in organization on wages and productivity. The measure is defined by them as “the logarithm of the average real piece rate times the loom complement” ([Lazonick and Brush, 1985](#), p. 93). The loom complement is included because it incorporates the fact that workers sometimes moved from tending 2 to 3 or 3 to 4 looms in a particular month, which would clearly affect their productivity and thus earnings. Piece rates were announced at the beginning of the month and workers were paid at the end of the month – this fact was stated on the “Regulation Papers” which were considered part of the workers’ contract.² Thus, the time window for labor supply decisions was clearly defined by month.

It is unclear exactly how wage policy was undertaken by mill owners, but historical scholarship suggests that piece rates were cut, or increased, due to fluctuations in profitability across all mills in a particular town. The reason for this coordinated approach to policy is that the mills in a specific town were often all controlled

¹ The data we employ have been used by a wide range of scholars interested in different aspects of the mill’s history. [David \(1975\)](#) used mill data to study the “Horndal effect”, a phenomenon whereby productivity growth occurs in the absence of technological change. The Horndal effect was later analyzed by [Lazonick and Brush \(1985\)](#). We use parts of Lazonick and Brush’s dataset for the bulk of our analysis. [Bessen \(2003\)](#) used some variables from the dataset in his study of human capital formation and technological growth at the mills. Many eminent social historians, such as Thomas Dublin, have analyzed records from the textile mills such as the Hamilton company, which was another textile mill located near the Lawrence #2 mill and which operated around the same time period.

² One example of such a regulation, common throughout the mills, can be found here: “Regulations to be Observed by Persons Employed in the Boott Cotton Mills”, *Massachusetts Historical Society*, accessed on October 16, 2014 at <http://www.masshist.org/object-of-the-month/objects/regulations-to-be-observed-by-persons-employed-in-the-boott-cotton-mills-2012-03-01>.

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