Stock Market Wealth and the Real Economy: A Local Labor Market Approach*

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Abstract

We provide evidence on the stock market consumption wealth effect by using a local labor market analysis and regional heterogeneity in stock market wealth. An increase in local stock wealth driven by aggregate stock prices increases local employment and payroll in nontradable industries and in total, while having no effect on employment in tradable industries. In a model with consumption wealth effects and geographic heterogeneity, these responses imply a marginal propensity to consume out of a dollar of stock wealth of 2.8 cents per year. We also use the model to quantify the aggregate effects of a stock market wealth shock when monetary policy is passive. A 20% increase in stock valuations, unless countered by monetary policy, increases the aggregate labor bill by at least 0.85% and aggregate hours by at least 0.28% two years after the shock.

JEL Classification: E44, E21, E32

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1 Introduction

According to a recent textual analysis of FOMC transcripts by Cieslak and Vissing-Jorgensen (2017), many U.S. policymakers believe that stock market fluctuations affect the labor market through a consumption wealth effect. In this view, a decline in stock prices reduces the wealth of stock-owning households, causing a reduction in spending and hence in employment. While apparently an important driver of U.S. monetary policy, this channel has proved difficult to establish empirically. The main challenge arises because stock prices are forward-looking. Therefore, a decline in expected TFP could also lead to both a negative stock return and a subsequent decline in household spending and employment.

We use a local labor market analysis to address this empirical challenge and provide quantitative evidence on the stock market consumption wealth effect. Our empirical strategy exploits regional heterogeneity in stock market wealth to identify the causal effect of stock price changes on labor market outcomes. To guide and interpret the empirical analysis, we present a model featuring regional heterogeneity in stock wealth.

We start by presenting the theory. The model environment features a continuum of areas, a tradable good and a nontradable good, and two factors of production, capital and labor. Capital ownership is heterogeneous across areas, mirroring the regional heterogeneity in stock wealth in the data. The price of capital is endogenous and can change due to changes in households' beliefs about the expected future productivity of capital (equivalently, due to changes in risk aversion or risk). Thus, stock prices can change without any change in the productivity of the economy in the short run, consistent with a large finance literature (Cochrane, 2011; Campbell, 2014).

In the model, changes in the price of capital impact local labor markets more in areas with greater capital ownership. The main mechanism is a wealth effect: an increase in local stock wealth increases local spending on nontradable goods. Higher spending drives up the labor bill and increases employment in the nontradable sector and in total. Local wages weakly increase, which induces a (weak) fall in tradable employment. The functional forms of these relationships, which relate log changes in employment and payroll to the change in local wealth normalized by the local labor bill, guide our empirical analysis.

We use regional variation in stock market wealth to investigate empirically how changes in local stock wealth driven by aggregate stock price changes affect local labor market outcomes. We measure county-level stock market wealth by capitalizing dividend income reported on tax returns. We interact the local stock market wealth with the return on the S&P 500 index and normalize by local labor income to obtain our "stock market wealth shock" measure for each area and quarter. We merge these data with administrative employment and payroll data from the Quarterly Census of Employment and Wages (QCEW) to obtain our labor market outcome variables. Our preferred specification controls for county fixed effects, state-by-quarter fixed effects, and a Bartik employment shock based on 3-digit NAICS employment shares. Thus, our identifying assumption is that, following a positive stock return, areas with high stock market wealth do not experience unusually rapid employment or payroll growth (relative to other counties in the same state and conditional on their industrial composition) for reasons other than the wealth effect on local spending.

An increase in local stock wealth induced by a positive return on the S&P 500 index increases total local employment and payroll. Seven quarters after an increase in stock market wealth equivalent to 1% of local labor market income, local employment is 0.69 basis points higher and local payroll is 2.25 basis points higher. Because stock returns are nearly i.i.d., these responses reflect the short-run effect of a permanent change in stock market wealth. Motivated by our model, we also investigate the effect on employment and the labor bill in the nontradable and tradable industries, following the sectoral classifications in Mian and Sufi (2014). Consistent with the theory, the employment response in nontradable industries exceeds the overall response, while employment in tradable industries does not increase. We also report a large response in the residential construction sector, again consistent with a household demand channel. Finally, we find evidence that the nontradable labor bill responds more strongly to stock market wealth changes in less wealthy states.

The main threat to a causal interpretation of these findings is that high wealth areas respond differently to other aggregate variables that co-move with the stock market. The absence of "pre-trend" differences in outcomes in the quarters before a positive stock return and the non-response of employment in the tradable sector support a causal interpretation. A decomposition along the lines of Andrews et al. (2017) shows that no single state drives the results. We further show robustness along a number of dimensions, including: using a more parsimonious specification with only county and time fixed effects; including interactions of stock market wealth with other aggregate variables such as TFP growth, GDP growth, or the change in interest rates to allow wealthier counties to have different loadings on these variables; controlling for local house prices; using only within commuting zone variation in stock market wealth; subsample analysis including dropping the wealthiest counties and the quarters with the most volatile stock returns; and not weighting the regression. These exercises exploit the substantial variation in stock returns that occurs independent of other macroeconomic variables.

We combine our empirical results with the theoretical model to calibrate two key parameters: the strength of the direct stock wealth effect and the degree of local wage adjustment. To calibrate the stock wealth effect, we provide a separation result from our model that decomposes the empirical coefficient on the *nontradable* labor bill into the product of three terms: the partial equilibrium marginal propensity to consume out of stock market wealth, the local Keynesian multiplier (equivalent to the multiplier on local government spending), and the labor share of income.[1] We use standard values from previous literature to calibrate the labor share of income and the local Keynesian multiplier. Given these values, the empirical response of the nontradable labor bill implies that in partial equilibrium a one dollar increase in stock-market wealth increases annual consumption expenditure by about 2.8 cents two years after the shock. For the degree of wage adjustment, comparing the response of total employment with the response of the total labor bill suggests that a 1 percent increase in labor (total hours worked) is associated with a 1.2 percent increase in wages at a two year horizon.

Finally, we use the model to quantify the *aggregate* effects that stock price shocks would generate if monetary policy (or other demand-stabilization policies) did not respond to the shock. We first show that, with homothetic preferences and production across sectors, a one dollar increase in stock market wealth has the same *proportional* effect on the nontradable and total labor bills, up to an adjustment for the difference in the local and aggregate spending multipliers. We then consider a 20% positive shock to stock valuations—approximately the yearly standard deviation of stock returns. Using our empirical estimate for the nontradable labor bill, and applying a bounding argument for moving from local to aggregate effects similar to that in Chodorow-Reich (2019), this shock would increase the aggregate labor bill by at least 0.85% two years after the shock. Combining this effect with the degree of aggregate wage adjustment implied by our local estimates, the shock would also increase aggregate hours by at least 0.28%.

The rest of the paper is organized as follows. We start by discussing the related literature. Section 2 describes our theoretical framework. Section 3 describes the data sets and the construction of our main variables. Section 4 presents the baseline empirical specification and discusses conditions for causal inference. Section 5 contains the empirical results. Section 6 uses the empirical results to calibrate the model and derive the partial equilibrium wealth effect. Section 7 calculates the implied aggregate wealth effects, and Section 8 concludes.

Related literature. Our paper contributes to a large literature that investigates the relationship between stock market wealth, consumption, and the real economy. A major challenge is to disentangle whether the stock market has an effect on consumption over a rel-

[1] In general, there may be an additional term reflecting the response of output in the tradable sector when relative prices change across areas. This term disappears in our benchmark calibration, which features Cobb-Douglas preferences across tradable goods produced in different regions. Allowing for a non-unitary elasticity of substitution across regions does not meaningfully change our conclusions.

atively short horizon (the direct wealth effect), or whether it simply predicts future changes in productivity, income, and consumption (the leading indicator effect). The challenge is compounded by the scarcity of data sets that contain information on household consumption and financial wealth. The recent literature has tried to address these challenges in various ways (see Poterba (2000) for a survey of the earlier literature).

The literature using aggregate time series data finds mixed evidence (see e.g. Poterba and Samwick, 1995; Davis and Palumbo, 2001; Lettau et al., 2002; Lettau and Ludvigson, 2004; Carroll et al., 2011). However, an aggregate time series approach introduces a complication: in an environment in which monetary policy effectively stabilizes aggregate demand fluctuations, as in our model, there can be strong wealth effects and yet no relationship between asset price shocks and aggregate consumption (see Cooper and Dynan (2016) for other issues with using aggregate time series in this context).

Another strand of the literature uses household level data and exploits the heterogeneity in household wealth to isolate the stock wealth effect. Dynan and Maki (2001) use Consumer Expenditure Survey (CE) data to compare the consumption response of stockholders with non-stockholders. They find a relatively large marginal propensity to consume (MPC) out of stock wealth—around 5 to 15 cents per dollar per year. However, Dynan (2010) re-examines the evidence by extending the CE sample to 2008 and finds weaker effects. More recently, Di Maggio et al. (2018) use detailed individual-level administrative wealth data for Sweden to identify the stock wealth effect from variation in individual-level portfolio returns. They find substantial effects: the top 50% of the income distribution, who own most of the stocks, have an estimated MPC of around 5 cents per dollar per year.[2]

We complement these studies by focusing on *regional* heterogeneity in stock wealth. We show how the regional empirical analysis can be combined with a model to estimate the household-level stock wealth effect. The MPC implied by our analysis (2.8 cents per dollar per year) is close to estimates from the recent literature. Also, consistent with Di Maggio et al. (2018), we find evidence for a heterogeneous response depending on the wealth level. An additional advantage of our approach is that it directly estimates the local *general equilibrium* effect. In particular, by examining the labor market response, we provide direct evidence on the margin most important to monetary policymakers.

Case et al. (2005) and Zhou and Carroll (2012) also use regional variation to estimate financial wealth effects. Case et al. (2005) overcome the absence of geographic data on financial wealth by using state-level mutual fund holdings data from the Investment Company Institute (ICI) and measure state consumption using retail sales data from the Regional

[2]See also Bostic et al. (2009) and Paiella and Pistaferri (2017) for similar analyses of stock wealth effects in different contexts.

Financial Associates. Zhou and Carroll (2012) criticize the data construction and empirical specification in Case et al. (2005) and construct their own data set using proprietary data on state-level financial wealth and retail sales taxes as a proxy for consumption. Both papers find negligible stock wealth effects and a sizable housing wealth effect. Relative to these papers, we exploit the much greater variation in financial wealth across counties than across states and provide evidence on the labor market margin directly. Other recent papers use regional variation but focus only on estimating housing wealth effects (Mian et al., 2013; Mian and Sufi, 2014; Guren et al., 2018).[3]

Our focus on the consumption wealth channel complements research on the investment channel of the stock market that dates to Tobin (1969) and Hayashi (1982). Under the identifying assumptions we articulate below, our local labor market analysis absorbs the effects of changes in Tobin's Q or the cost of equity financing on investment into a time fixed effect, allowing us to isolate the consumption wealth channel.

Our theoretical framework builds upon the model in Mian and Sufi (2014) by incorporating several features important for a structural interpretation of the results, including endogenous changes in wealth, monetary policy, partial wage adjustment, and imperfectly substitutable tradable goods. Our framework also shares features with models of small open economies with nominal rigidities (e.g. Gali and Monacelli, 2005) adapted to the analysis of monetary unions by Nakamura and Steinsson (2014) and Farhi and Werning (2016), but differs from these papers by including a fully nontradable sector. This feature facilitates the structural interpretation and aggregation of the estimated local general equilibrium effects.

Our structural interpretation and aggregation results represent methodological contributions that apply beyond our particular model. First, and similar to the approach in Guren et al. (2018) and formalized in Guren et al. (in progress), we illustrate how the estimated local general equilibrium effects can be combined with (external) estimates of the local income multiplier to obtain the partial equilibrium spending effect. Our decomposition differs from theirs in that it applies to the coefficient for the nontradable labor bill—a variable that is easily observable at the regional level—and therefore includes an adjustment for the labor share of income. Second, we show how, under standard assumptions, the response of the local labor bill in the *nontradable* sector provides a direct and transparent bound for the response of the aggregate effect across *all* sectors when monetary policy does not react.

Finally, our paper relates to a literature that studies the monetary policy response to asset price fluctuations. Rigobon and Sack (2003), Bjørnland and Leitemo (2009), and more recently Cieslak and Vissing-Jorgensen (2017) show that monetary policy responds to the

[3]See also Case et al.(2005; 2011), Campbell and Cocco (2007), Mian and Sufi (2011), Carroll et al. (2011), and Browning et al. (2013), among others.

stock market. Caballero and Simsek (2017) argue that the monetary policy response to asset price fluctuations mitigates demand recessions, and empirically support this view by comparing the severity of recessions following house price declines within and outside the Eurozone. Our paper complements their findings by showing that stock price declines (which are unrelated to short-run productivity) would reduce aggregate employment if monetary policy did not respond.[4]

2 Theoretical Predictions

This section develops a stylized theoretical model to guide and interpret the empirical analysis. We present the main equations and results in the main text and relegate additional details to Appendix A. We use the model to illustrate the aggregate and cross-sectional effects of changes in stock wealth and to motivate our empirical specification. In Section 6 we use the empirical results to calibrate the model.

The model consists of a continuum of areas denoted by subscript a and two time periods denoted by subscripts 0 and 1. We interpret period 1 as the long-run, in which prices adjust and macroeconomic outcomes are determined solely by productivity. In contrast, period 0 is the short-run in which aggregate demand can matter. Hence, a period in the model may correspond to several years. There are two factors of production, labor and capital. Labor is specific to the area in period 0, which ensures that wages and employment in the short run are influenced by local demand. Capital is mobile across areas (in either period), which simplifies the analysis by ensuring that capital has a single price. The price of capital in period 0 is endogenous and can change due to fluctuations in its expected productivity in period 1. Importantly, capital ownership is heterogeneous across areas. We analyze how changes in the price of capital affect local labor market outcomes. We also separately model nontradable and tradable goods, which yields additional predictions and will play an important role in the calibration.

2.1 Environment and Equilibrium

In each period $t \in \{0, 1\}$ and area a, a representative household divides its consumption $C_{a,t}$ between a tradable good that can be transported costlessly across areas, $C^T_{a,t}$, and a nontradable good that must be consumed in the area where it is produced, $C^N_{a,t}$, according

[4] Earlier literature is skeptical about whether such a response is welfare improving. Specifically, Bernanke et al. (1999; 2001) and Gilchrist and Leahy (2002) argue that there is little additional benefit for an inflation-targeting central bank to target asset prices generally and the stock market in particular beyond the informational content of asset prices for future inflation.

to the preferences:

$$C_{a,t} = \left(C_{a,t}^N/\eta\right)^\eta \left(C_{a,t}^T/\left(1-\eta\right)\right)^{1-\eta}.$$

Competitive firms produce the nontradable good $Y_{a,t}^N$ using labor $L_{a,t}^N$ and capital $K_{a,t}^N$ and the Cobb-Douglas technology:

$$Y_{a,t}^N = F\left(K_{a,t}^N, L_{a,t}^N\right) = \left(K_{a,t}^N/\alpha\right)^\alpha \left(L_{a,t}^N/\left(1-\alpha\right)\right)^{1-\alpha}.$$

There are two technologies for producing the tradable consumption good Y_t^T:

$$Y_t^T = \left(\int_a F\left(K_{a,t}^T, L_{a,t}^T\right)^{\frac{\varepsilon-1}{\varepsilon}} da\right)^{\frac{\varepsilon}{\varepsilon-1}} + G_t\left(\tilde{K}_t^T\right).$$

The first technology uses tradable inputs produced in each area using local labor $L_{a,t}^T$ and capital $K_{a,t}^T$ and the Cobb-Douglas technology:

$$F\left(K_{a,t}^T, L_{a,t}^T\right) = \left(K_{a,t}^T/\alpha\right)^\alpha \left(L_{a,t}^T/\left(1-\alpha\right)\right)^{1-\alpha}.$$

The elasticity of substitution $\varepsilon > 0$ governs the effect of unit costs in an area on the aggregate expenditure on exports from that area.

The second technology uses only capital $\tilde{K}_t^T$:

$$G_t\left(\tilde{K}_t^T\right) = D_t^{1-\alpha}\tilde{K}_t.$$

The productivity parameter D_t determines the rental rate of capital. We will obtain changes in stock prices in period 0 by varying the future productivity of this technology, D_1.

Areas are identical except for their initial capital wealth. Specifically, the representative household in area a enters period 0 owning $1 + x_{a,0}$ units of capital, where $\int_a x_{a,0} da = 0$. We let Q_0 denote the (cum-dividend) price of capital at the beginning of period 0 and normalize the aggregate capital supply to one. Therefore, $\left(1 + x_{a,0}\right) Q_0$ denotes the value of capital and, hence, the stock market wealth held by households in area a at the start of period 0. Consequently, the distribution of capital ownership, $\left\{x_{a,0}\right\}_a$, determines the cross sectional heterogeneity of stock wealth.

The representative household in each area separates its consumption and labor choices as follows. At the beginning of period 0, the household splits into a consumer and a continuum of workers.[5] The consumer makes a consumption-savings decision to maximize a time-separable

[5] We choose to model consumption and labor decisions separately for two reasons. First, assuming workers choose labor according to Greenwood et al. (1988) (GHH) preferences allows us to ignore the wealth effects of labor supply. Second, we can endow consumers with standard time-separable preferences. In addition to

log utility function subject to an intertemporal budget constraint:

$$\max_{C_{a,0},C_{a,1}} \log C_{a,0} + \delta \log C_{a,1} \tag{1}$$

$$\text{s.t.} \qquad P_{a,0}C_{a,0} + \frac{P_{a,1}C_{a,1}}{R^f} = W_{a,0}L_{a,0} + (1 + x_{a,0})\, Q_0 + \frac{W_{a,1}L_{a,1}}{R^f}. \tag{2}$$

Here, $P_{a,t}$ denotes the price level in period t in area a, $W_{a,t}$ the wage level, $L_{a,t}$ labor supply, and R^f the risk-free rate. The elasticity of intertemporal substitution (EIS) of one simplifies the analysis and is empirically plausible (see Appendix A.9 for a discussion of how a more general EIS affects our analysis).

In period 1 (the long run) labor is exogenous, $L_{a,1} = \overline{L}_1$, for all a, and the nominal wage is constant, $W_{a,1} = \overline{W}$. We model period 0 labor supply to incorporate both some degree of wage stickiness and a disutility of labor. Specifically, a worker of type ν supplies labor $L_{a,0}(\nu)$ subject to a constant elasticity labor demand curve.[6] A fraction of the labor types (the sticky workers) supply labor at the preset wage $\overline{W}$ (the same wage as in the long-run). The remainder (the flexible workers) set a wage $W_{a,0}(\nu)$ to maximize:

$$\log \left(C_{a,0} - \frac{\chi}{1+\varphi} \int_0^1 L_{a,0}(\nu)^{1+\varphi}\, d\nu \right), \tag{3}$$

where φ denotes the inverse of the Frisch elasticity of labor supply. Thus, the worker chooses labor according to Greenwood et al. (1988) preferences in Eq. (3), which omit a wealth effect on labor supply.

In Online Appendix A.1, we derive the optimal wage set by flexible workers and combine it with the wage of the sticky workers to obtain a labor supply curve (c.f. Eq. (A.19)). We linearize the resulting equation around a benchmark in which all areas have common wealth to derive the log-linear labor supply curve (c.f. Eq. (A.57)):

$$\log \frac{W_{a,0}}{\overline{W}} = \lambda \left(\log \frac{P_{a,0}}{\overline{P}} + \varphi \log \frac{L_{a,0}}{\overline{L}_0} \right). \tag{4}$$

Here, $\overline{P}$ and $\overline{L}_0$ denote the price level and labor that would obtain if all areas had the same wealth, and $\lambda \in [0,1]$ is a meta-parameter that is decreasing in the degree of wage stickiness. When $\lambda = 0$, wages are fully sticky. When $\lambda = 1$, wages are fully flexible and the equation

simplifying the subsequent expressions, this setup accords with the fact that workers hold relatively little stock market wealth. At the same time, we sidestep some consequences of GHH preferences, such as leading to unplausibly large fiscal and monetary multipliers (Auclert and Rognlie, 2017).

[6]Formally, the worker faces the labor demand curve $L_{a,0}(\nu) = \left(\frac{W_{a,0}(\nu)}{W_{a,0}}\right)^{-\varepsilon_w} L_{a,0}$, where $W_{a,0} = \left(\int_0^1 W_{a,0}(\nu)^{1-\varepsilon_w}\, d\nu\right)^{1/(1-\varepsilon_w)}$ and $L_{a,0} = \left(\int_0^1 L_{a,0}(\nu)^{\frac{\varepsilon_w - 1}{\varepsilon_w}}\, d\nu\right)^{\frac{\varepsilon_w}{\varepsilon_w - 1}}$.

reduces to a neoclassical labor supply relationship between labor and the real wage.[7]

Finally, at the end of period 0 the household recombines and makes a portfolio decision to allocate savings between capital (stock wealth) and a risk-free asset. The risk-free asset is in zero net supply and generates a gross nominal return in period 1 denoted by R^f. The monetary policy sets R^f to keep labor supply equal to its frictionless level on average. Specifically, it ensures $\int_a L_{a,0} da = \overline{L}_0$, where $\overline{L}_0$ denotes the labor supply that would obtain if all areas had the same stock wealth and there were no wage rigidities. Appendix A.1 completes the description of the setup and defines the equilibrium.

2.2 Consumption Wealth Effect

In Appendix A.2, we characterize the equilibrium and establish the key mechanism behind our results: the consumption wealth effect. Specifically, in view of the preferences in (1), the time-zero consumption expenditure in area a satisfies:

$$P_{a,0} C_{a,0} = \frac{1}{1+\delta} \left(H_{a,0} + \left(1 + x_{a,0}\right) Q_0 \right). \tag{5}$$

Here, $H_{a,0}$ denotes human capital wealth, the present discounted value of labor income. Hence, we have the standard result with log utility that consumption expenditure is a fraction of lifetime wealth.

We now solve for the endogenous variables, first in a benchmark case in which areas have common wealth and then by linearizing the equilibrium equations around that benchmark. We use the common wealth benchmark to illustrate the source of stock price fluctuations, and we use the log-linearized equilibrium to describe the regional effects of these fluctuations.

2.3 Stock Price Fluctuations With Common Wealth

First suppose all areas have the same stock wealth, $x_{a,0} = 0$ for each a. In this case, the equilibrium allocations and prices are the same across areas, so we drop the subscript a. We solve for the equilibrium in Appendix A.3. We make a parametric assumption on D_0 to ensure that firms are indifferent to using the capital-only technology in period 0 (but they

[7] Letting λ_w denote the fraction of flexible workers that reset wages in period 0, $\lambda = \frac{\lambda_w}{1+(1-\lambda_w)\varphi\varepsilon_w}$.

do use it in period 1).[8] In this case, the equilibrium is particularly simple and given by:

$$\begin{aligned} W_0 &= \overline{W}, \quad L_0 = \overline{L}_0 \text{ where } \overline{L}_0 \text{ solves } (A.38), \\ L_0^N &= \eta \overline{L}_0, L_0^T = (1-\eta)\overline{L}_0, \\ R^f &= R^{f,*} = \frac{1}{\delta}\frac{\overline{L}_1 + D_1}{\overline{L}_0 + D_0}, \\ Q_0/\overline{W} &= D_0 + \frac{D_1}{R^f} = D_0 + \delta\left(\overline{L}_0 + D_0\right)\frac{D_1}{\overline{L}_1 + D_1}, \\ H_0/\overline{W} &= \overline{L}_0 + \frac{\overline{L}_1}{R^f} = \overline{L}_0 + \delta\left(\overline{L}_0 + D_0\right)\frac{\overline{L}_1}{\overline{L}_1 + D_1}. \end{aligned} \tag{6}$$

The first line shows that the nominal wage is equal to its long-run level and labor supply is given by its frictionless level (see the appendix for a characterization). The second line shows that the share of labor employed in each sector is determined by the sectoral shares in household spending. The third line characterizes the interest rate that brings about this outcome ("rstar").

The last two lines characterize the prices of physical and human capital. An increase in the future productivity of capital, D_1, increases the equilibrium price of capital Q_0. Monetary policy responds to this change by raising R^f; however, the equilibrium price of capital increases even after incorporating the monetary policy response.

We focus on the comparative statics of a change in the productivity of capital from some D_1^{old} to D_1^{new}. By Eq. (6), the price of capital changes from Q_0^{old} to some Q_0^{new}, while leaving the aggregate labor market outcomes unchanged, $L_0 = \overline{L}_0, W_0 = \overline{W}$. In the rest of the analysis, we investigate how this change affects *local* labor market outcomes when stock wealth is heterogeneously distributed across areas. In Appendix A.8, we generalize the analysis to incorporate uncertainty over D_1 and show that our analysis is robust to other sources of fluctuations in Q_0, such as changes in the level of uncertainty or changes in risk aversion.[9]

[8] For simplicity, we assume the capital-only technology can be used to produce tradables but not nontradables. This provides a potential source of nonhomotheticity across sectors. The assumption on D_0 ensures that production remains homothetic in period 0, which is important for some of our results. It also simplifies the expressions, e.g., it implies the share of labor in period 0 is given by its share in the Cobb-Douglas technology, $1-\alpha$.

[9] Specifically, we show that a reduction in households' perceived uncertainty about D_1 increases Q_0 and $R^{f,*}$. After extending the analysis to more general Epstein-Zin preferences, we also establish that a decrease in households' relative risk aversion parameter increases Q_0 and $R^{f,*}$ (see Proposition 3). Finally, we show that, conditional on generating the same increase in Q_0, the decline in risk or risk aversion has the same *quantitative* effects on local labor market outcomes as in our baseline model.

2.4 Empirical Predictions with Heterogeneous Wealth

We now derive predictions for the empirically-relevant case of a heterogeneous distribution of stock wealth. We also highlight the properties of the coefficients that will inform our calibration exercise.

We first log-linearize the equations that characterize the equilibrium around the common wealth benchmark for a given D_1. Specifically, we let $w_{a,0} = \log\left(W_{a,0}/\overline{W}\right), p_{a,0} = \log\left(P_{a,0}/\overline{P}\right)$ and $l_{a,0} = \log\left(L_{a,0}/\overline{L}_0\right)$ denote the log-deviations of nominal wages, nominal prices, and total labor for each area. We define $l_{a,0}^N$ and $l_{a,0}^T$ similarly for the nontradable and tradable sectors. In Appendix A.4 we present closed-form solutions for $p_{a,0}, w_{a,0}, l_{a,0}, l_{a,0}^N, l_{a,0}^T$ for a given level of D_1.

In particular, we express local prices in terms of local wages,

$$p_{a,0} = \eta\left(1-\alpha\right) w_{a,0}. \tag{7}$$

Combining this with Eq. (4), we obtain a reduced-form labor supply equation:

$$w_{a,0} = \kappa l_{a,0}, \text{ where } \kappa = \frac{\lambda\varphi}{1-\lambda\eta\left(1-\alpha\right)}. \tag{8}$$

Here, κ is a composite wage adjustment parameter that combines the effect of wage stickiness, λ, and the labor supply elasticity, $1/\varphi$. The parameter also depends on the share of nontradables, η, and the share of labor, $1-\alpha$, because these parameters determine the extent to which a change in local nominal wages affects local prices and therefore local real wages.

Our key predictions correspond to the comparative statics as D_1^{old} changes to D_1^{new}. Since the benchmark we log-linearize around does not change, the first-order effect on local labor market outcomes is characterized by changes in log-deviations. We solve for these changes as follows (see Appendix A.5):

$$\Delta\left(w_{a,0}+l_{a,0}\right) = \frac{1+\kappa}{1+\kappa\zeta}\mathcal{M}\left(1-\alpha\right)\eta\frac{1}{1+\delta}\frac{x_{a,0}\Delta Q_0}{\overline{W}\overline{L}_0}, \tag{9}$$

$$\Delta l_{a,0} = \frac{1}{1+\kappa}\Delta\left(w_{a,0}+l_{a,0}\right), \tag{10}$$

$$\Delta\left(w_{a,0}+l_{a,0}^N\right) = \mathcal{M}\left(1-\alpha\right)\frac{1}{1+\delta}\left[\frac{x_{a,0}\Delta Q_0}{\overline{W}\overline{L}_0} + \left(1-\eta\right)\Delta\left(w_{a,0}+l_{a,0}^T\right)\right], \tag{11}$$

$$\Delta\left(w_{a,0}+l_{a,0}^T\right) = -\left(\varepsilon-1\right)\left(1-\alpha\right)\Delta w_{a,0}, \tag{12}$$

$$\text{where } \mathcal{M} = \frac{1}{1-\left(1-\alpha\right)\eta/\left(1+\delta\right)}$$

and $\zeta = 1 + (\varepsilon - 1)(1 - \alpha)(1 - \eta)\mathcal{M}$.

Here, $\Delta y \equiv y^{new} - y^{old}$ denotes the change in equilibrium variable y. In particular, $\Delta Q_0 = Q_0^{new} - Q_0^{old}$ denotes the dollar change in the aggregate stock wealth. Thus, $x_{a,0}\Delta Q_0$ denotes the change in stock wealth in area a relative to other areas. The equations describe how the (relative) stock wealth change normalized by the labor bill, $\frac{x_0 \Delta Q_0}{WL_0}$, affects the (relative) local labor market outcomes in the area.

These equations are intuitive. Eq. (9) shows that an increase in stock wealth in an area increases the total labor bill. To understand the coefficient, note that one more dollar of stock wealth in an area leads to $1/(1+\delta)$ dollars of additional total spending (cf. Eq. (5)), of which $\eta/(1+\delta)$ is spent on nontradable goods produced locally. The increase in spending, in turn, increases the local labor bill by $(1-\alpha)\eta/(1+\delta)$ dollars. This direct effect gets amplified by the local Keynesian income multiplier, denoted by $\mathcal{M}$. The remaining term, $\frac{1+\kappa}{1+\kappa\zeta}$, reflects potential adjustments to the labor bill due to changes in exports to other areas. Specifically, an increase in local wages makes the areas's goods more expensive, which reduces (resp. increases) the tradable labor bill (and thus the total labor bill) when tradable inputs are gross substitutes, $\varepsilon > 1$ (resp. gross complements, $\varepsilon < 1$).

Eq. (10) is a rearrangement of the reduced-form labor supply equation in (8), which relates changes in labor to changes in the labor bill according to the wage adjustment parameter, κ. In particular, how much employment responds relative to the total labor bill (given a change in stock wealth) will discipline κ in our calibration exercise.

Eqs. (11) and (12) characterize the effects on the labor bill separately for the nontradable and tradable sectors. These equations are particularly simple when tradable inputs have unit elasticity, $\varepsilon = 1$. In this case, the effect on the tradable labor bill is zero, $\Delta\left(w_{a,0} + l_{a,0}^T\right) = 0$. The coefficient multiplying the wealth change for the nontradable labor bill can be decomposed into three terms: the partial equilibrium marginal propensity to consume (MPC) out of stock market wealth $1/(1+\delta)$, the labor share of income $1-\alpha$, and the local multiplier $\mathcal{M}$. In Section 6 we use this decomposition to recover the partial equilibrium MPC given externally calibrated α and $\mathcal{M}$. Notably, the expression does not require information on the share of nontradables in spending, η.

When $\varepsilon \neq 1$, the decomposition for the nontradable sector does not hold exactly. In this case, as illustrated by Eq. (12), the stock wealth shock can affect the tradable labor bill if it has an effect on wages. As illustrated by Eq. (11), this affects local households' income and, therefore, creates knock-on effects in the nontradable sector (captured by the additional term in brackets). However, if wages do not adjust much, then the tradable adjustment has a small impact on the analysis even when ε is somewhat different from 1.

2.5 Summary and Implications

According to Eqs. (9) to (12), an increase in *national* stock prices driven by, e.g., changes in expected *future* productivity of capital or in risk aversion, increases the *current* total labor bill and nontradable labor bill by more in areas with greater stock market wealth. The effect on the tradable labor bill is ambiguous and depends on whether tradable inputs are gross substitutes or complements. In Appendix A.4, we derive the additional predictions that nontradable employment, total employment, and wages weakly increase, and tradable employment weakly falls.

The model motivates the regressions we analyze in our empirical analysis. In particular, define $S_{a,0} \equiv \frac{x_{a,0}Q_0}{\overline{W}L_0}$ as area a's (relative) stock wealth divided by its labor bill and $R_0 \equiv \frac{\Delta Q_0}{Q_0}$ as the stock return. Then, we have:

$$S_{a,0}R_0 = \frac{x_{a,0}\Delta Q_0}{\overline{W}L_0}. \tag{13}$$

Hence, $S_{a,0}R_0$ captures the change in the stock wealth of the area normalized by the local labor bill. Eqs. (9) to (12) illustrate that regressions of log changes in local labor market outcomes on this variable yield coefficients tightly related to the key parameters of the model, a mapping we exploit in Section 6. As emphasized by Dynan and Maki (2001), such "dollar-dollar" specifications arise naturally in consumption-wealth models.[10]

3 Data

In this section we explain how we measure the key objects introduced by the theory: the ratio of geographic stock market wealth to labor income, the stock market return, employment, and payroll. Our geographical unit is a U.S. county. This level of aggregation leaves ample variation in stock market wealth while being large enough to encompass a substantial share of spending by local residents. The U.S. contains 3,142 counties using current delineations.

3.1 Stock Market Wealth and Stock Market Return

Motivated by Eq. (13), we define our main regressor $S_{a,t-1}R_{t-1,t}$ as the product of stock market wealth in county a in period $t-1$ and the market return between $t-1$ and t, normalized by the period $t-1$ labor bill.

[10] An alternative approach would be to estimate an elasticity and to convert back into a dollar-dollar coefficient using the sample average ratio of stock market wealth to labor income (or consumption). This alternative has the drawback that the actual ratio varies substantially over time as the stock market booms and busts, a problem noted in the very different context of fiscal multipliers by Ramey and Zubairy (2018).

Stock market wealth. We construct local stock market wealth by capitalizing dividend income. We start with IRS Statistics of Income (SOI) data containing county aggregates of annual dividend income reported on individual tax returns, over the period 1989-2015. Appendix B.1 describes these data and our sample construction in greater detail. Dividend income (reported on form 1040) includes any distribution from a C-corporation. It excludes distributions from partnerships, S-corporations, or trusts.[11] We define stock market wealth in a county as dividend income multiplied by the price-dividend ratio of the S&P500 stock market index, similar to the capitalization approaches of Mian et al. (2013) and Saez and Zucman (2016). We divide capitalized stock market wealth by SOI (annual) county labor income to arrive at our measure of local stock market wealth relative to labor income, $S_{a,t}$. Formally, denoting total reported dividend and labor income in year t for location a as $D_{a,t}$ and $W_{a,t}L_{a,t}$ and the price-dividend ratio on the S&P500 as Q_t/D_t, we construct

$$S_{a,t} = \frac{Q_t}{D_t}\frac{D_{a,t}}{W_{a,t}L_{a,t}}. \tag{14}$$

Figure 1a shows the variation in this measure across U.S. counties in 1990. Because of the regional differences, our baseline specification will exploit only within-state variation. Thus, Figure 1b and Figure 1c show the variation in 1990 and 2015, respectively, after removing state-specific means. The within-state differences are persistent over time, with a within-state correlation between $S_{a,1990}$ and $S_{a,2015}$ of 0.81. Table B.3 reports summary statistics for $S_{a,t}$ and other variables used in the analysis.

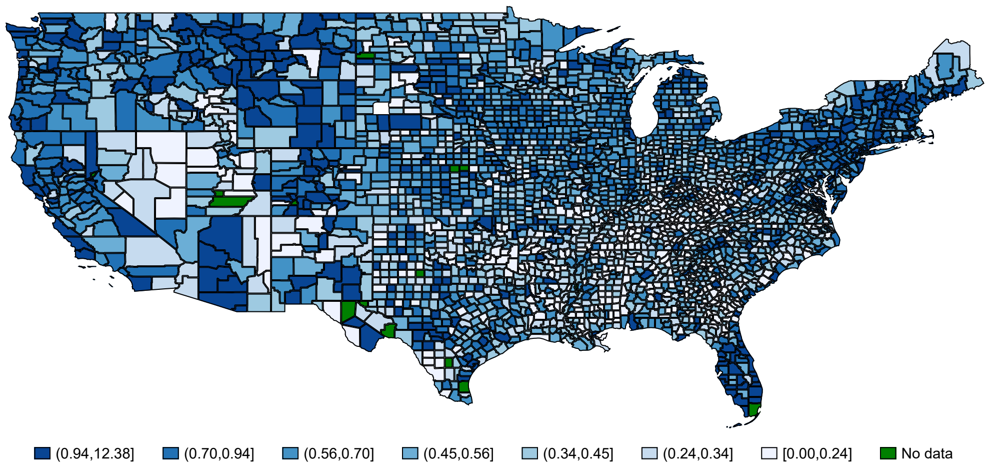
Stock market return. We equate the stock market return $R_{t-1,t}$ with the total return on the S&P500.[12] Figure 2a shows the serial correlation in quarterly returns during our sample period and Figure 2b the cumulative return following a one standard deviation increase in the stock market. As is well known, stock returns are nearly i.i.d., a result confirmed by the almost complete absence of serial correlation in Figure 2a. This pattern facilitates interpretation of our empirical results since it implies that a stock return in period t has a roughly permanent effect on wealth, and we mostly ignore the small momentum and subsequent reversal shown in Figure 2b in what follows. Figure 2c shows the correlation of the period t stock return with the change in other macroeconomic aggregate variables over the horizon $t-1$ to $t+h$. In our sample, the stock market return is positively correlated contemporaneously with utilization-adjusted TFP. It is correlated with the change in the

[11] Some S-corporations may also pay out dividends if they were previously C-corporations.

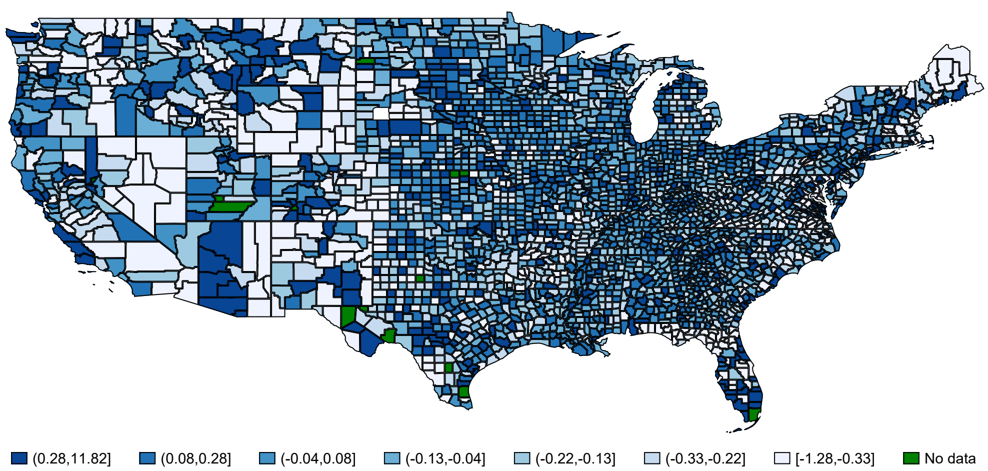
[12] We obtain the S&P500 total return and dividend-price ratio from Robert Shiller's website: http://www.econ.yale.edu/~shiller/data/ie_data.xls.

Figure 1: Stock Market Wealth Relative to Labor Income Across U.S. Counties.

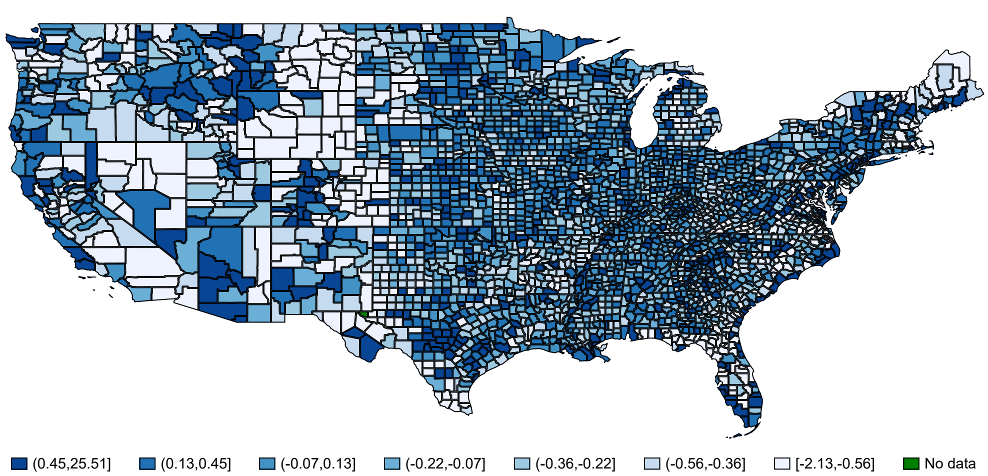
(a) 1990



(b) 1990, within state



(c) 2015, within state



short-term interest rate and GDP growth over the next several quarters.[13] However, the correlation coefficients are all well below one, reflecting the substantial movement in stock prices independent of economic fundamentals (Shiller, 1981; Cochrane, 2011; Campbell, 2014).

Measurement error. Appendix B.2 discusses possible measurement error in the capitalization approach arising from heterogeneous stock portfolios across counties, non-taxable retirement wealth, and dividends paid by non-public C-corporations. In brief, we show that purely idiosyncratic heterogeneity in stock portfolios (for example due to home bias) would not impact our results, because it would give rise to idiosyncratic changes in wealth that are uncorrelated with our main regressor. We present evidence from the Financial Accounts of the United States that retirement stock wealth (less than 20% of household equity wealth) and non-public C-corporations (less than 7% of total equity of C-corporations) are both too small to meaningfully affect our results. Furthermore, we show that household non-retirement and total stock market wealth move nearly one-for-one in the Survey of Consumer Finances (SCF) and report a specification below in robustness that uses SCF data to impute retirement wealth to counties.

3.2 Outcome Variables

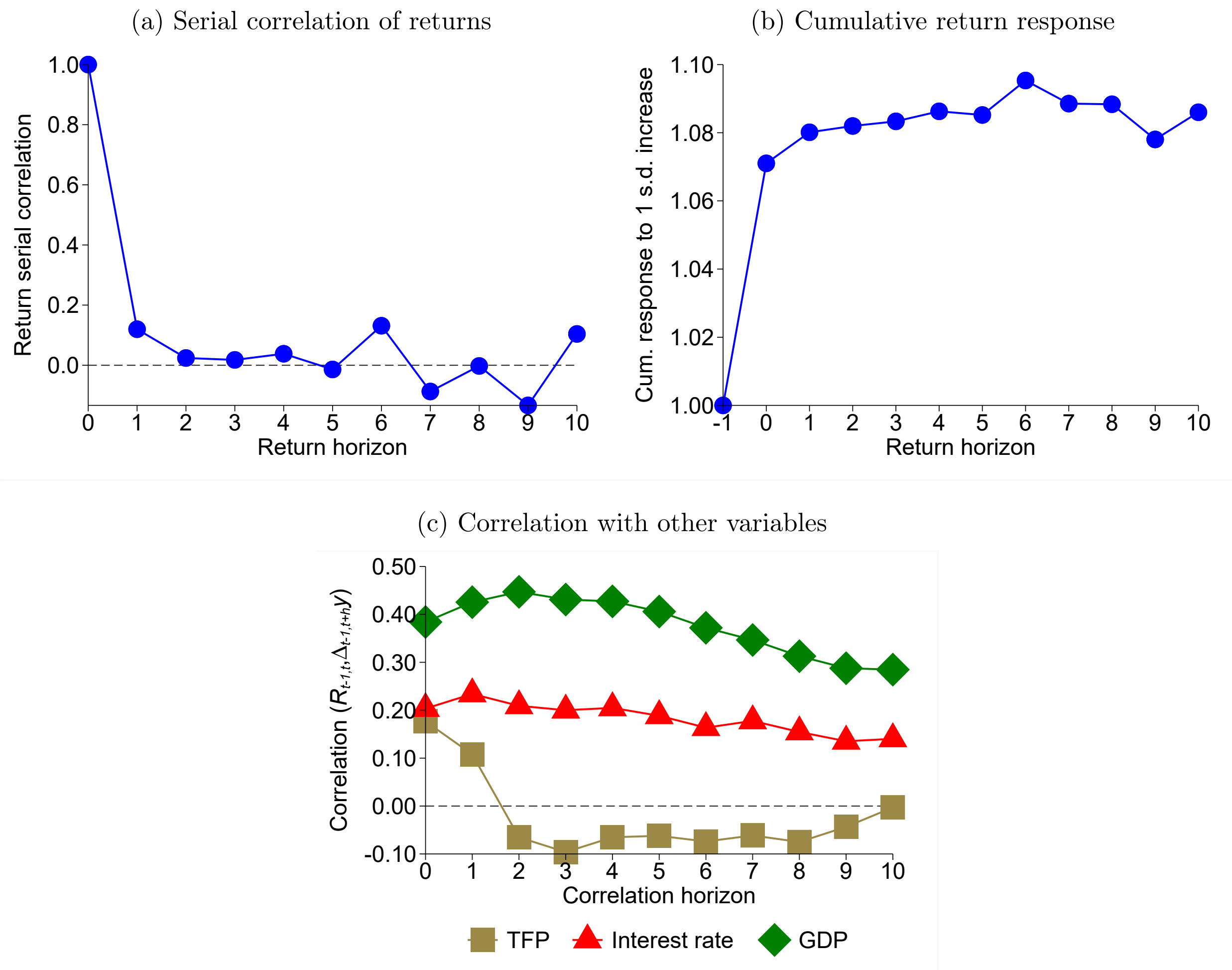
Our main outcome variables are log county-level employment and payroll from the Bureau of Labor Statistics Quarterly Census of Wages and Employment (QCEW). The source data for the QCEW are quarterly reports filed with state employment security agencies by all employers covered by unemployment insurance (UI) laws. The QCEW covers roughly 95% of total employment and payroll, making the data set a near universe of administrative employment records. We use the NAICS-based version of the data, which start in 1990, and seasonally adjust the published data by sequentially applying Henderson filters using the algorithm contained in the Census Bureau's X-11 procedure.[14] We follow Mian and Sufi (2014) and label NAICS codes 44-45 (retail trade) and 72 (accommodation and food services) as "nontradable" and NAICS codes 11 (agriculture, forestry, fishing and hunting), 21 (mining, quarrying, and oil and gas extraction), and 31-33 (manufacturing) as "tradable".[15]

[13] We use the version of utilization-adjusted TFP constructed by John Fernald and available at https://www.frbsf.org/economic-research/indicators-data/total-factor-productivity-tfp/. Here and later, the interest rate refers to the 3 month Treasury bill constant maturity rate.

[14] The NAICS version of the QCEW contains a number of transcription errors prior to 2001. We follow Chodorow-Reich and Wieland (2018, Appendix F) and hand-correct these errors before applying the seasonal adjustment procedure.

[15] Mian and Sufi (2014) exclude NAICS 721 (accommodation) from their definition of nontradable industries. We leave this industry in our measure to avoid complications arising from the much higher frequency of suppressed data in NAICS 3 than NAICS 2 digit industries in the QCEW data. The national share of

Figure 2: Attributes of S&P500 Quarterly Return



Notes: Panel (a) reports the coefficients β_h from estimating the regression $R_{t+h-1,t+h} = \alpha_h + \beta_h R_{t-1,t} + e_h$ at each quarterly horizon h shown on the lower axis, where $R_{t+h-1,t+h}$ is the total return on the S&P 500 between quarters $t+h-1$ and $t+h$. Panel (b) reports the transformation $\Pi_{h=0}^{j}\,(1+\beta_h\sigma_R)$ at each quarterly horizon j shown on the lower axis, where σ_R is the standard deviation of the S&P 500 return. Panel (c) reports the correlation coefficients of $R_{t-1,t}$ and $\Delta_{t-1,t+h}y$ at each quarterly horizon h shown on the lower axis, where $R_{t-1,t}$ is the total return on the S&P 500 in quarter t and $\Delta_{t-1,t+h}y$ is the change in variable y between quarter $t-1$ and $t+h$, for $y \in \{$utilization-adjusted log TFP, 3 month Treasury bill rate, log real gdp$\}$.

This classification is conservative in the sense that it leaves a large amount of employment unclassified and our calibration depends only on having a subset of industries that produce truly nontradable goods. On the other hand, even most manufacturing shipments occur within the same *zip code* (Hillberry and Hummels, 2008), which suggests local consumption demand could impact our measure of tradables.

4 Econometric Methodology

This section provides a formal discussion of causal identification, presents our baseline specification, and discusses the main threats to identification.

4.1 Framework

Our empirical implementation generalizes Eqs. (9) to (12) to allow for other differences across areas, other shocks, and higher frequency dynamics. We incorporate these elements by assuming the true data generating process takes the form:[16]

$$\Delta_{a,t-1,t+h}y = \beta_h[S_{a,t-1}R_{t-1,t}] + \Gamma_h' X_{a,t-1} + \epsilon_{a,t-1,t+h}, \tag{15}$$

where $\Delta_{a,t-1,t+h}y = y_{a,t+h} - y_{a,t-1}$ is the change in variable y in area a between $t-1$ and $t+h$, $S_{a,t-1}$ is stock market wealth in area a in period $t-1$ relative to labor market income in the area, $R_{t-1,t}$ is the return on the aggregate stock market between $t-1$ and t, $X_{a,t-1}$ collects included covariates determined (from the perspective of a local area) as of time $t-1$, β_h and Γ_h are coefficients (with the latter possibly vector-valued), and $\epsilon_{a,t-1,t+h}$ contains unmodeled determinants of the outcome variable.

Let $\hat{\beta}_h$ and $\hat{\Gamma}_h$ denote the coefficients from treating $\epsilon_{a,t-1,t+h}$ as unobserved and Eq. (15) as a Jordà (2005) local projection to be estimated by OLS. The identifying assumption for $plim \hat{\beta}_h = \beta_h$ is:

$$E\left[R_{t-1,t}\mu_t\right] = 0, \tag{16}$$

where $\mu_t \equiv E\left[S_{a,t-1}\epsilon_{a,t-1,t+h}\right]$ is a time t cross-area average of the product of stock wealth and the unobserved component.[17] Intuitively, this condition will not hold if the outcome

nontradable employment and payroll in NAICS 721 are both less than 8% and we have verified using counties with non-suppressed data that including this sector does not affect the nontradable responses reported below.

[16] With ex ante differences in labor income across areas, the denominator of $S_{a,t-1}$ becomes lagged labor income. Other shocks enter into $X_{a,t-1}$ if observed or $\epsilon_{a,t-1,t+h}$ if unobserved.

[17] To derive this condition, let $\boldsymbol{Y}$ denote the $AT \times 1$ vector of $\Delta_{a,t-1,t+h}y$ stacked over A areas and T time periods, $\boldsymbol{S}$ the $AT \times T$ matrix containing the vector $\begin{pmatrix} S_{1,t-1} & \dots & S_{A,t-1} \end{pmatrix}'$ in rows $A(t-1)+1$ to At

variable (e.g., employment or payroll) grows faster for unmodeled reasons ($\epsilon_{a,t-1,t+h} > 0$) in high wealth areas ($\Rightarrow \mu_t > 0$) in periods when the stock return is positive, and vice versa when the stock return is negative.

This exposition illustrates the connection between our research design and the more general shift-share design studied in Goldsmith-Pinkham et al. (2018) and Borusyak et al. (2018). Eq. (15) has a shift-share structure with a single shifter $R_{t-1,t}$ and area-specific loading $S_{a,t-1}$. The condition $E[R_{t-1,t}\mu_t] = 0$ coincides with the exogeneity condition in Borusyak et al. (2018) in the case of a single national observed shock and multiple (asymptotically infinite) areas and time periods. As in their framework, the condition recasts the identifying assumption from a panel regression into a single time series moment by defining the cross-area average μ_t. Borusyak et al. (2018) defend the validity of shift-share instruments when the shifter is exogenous, a seemingly natural assumption in our setting given that stock market index returns are nearly i.i.d. Nonetheless, since stock market returns are equilibrium outcomes (as most shifters are), identification of β_h also requires that other aggregate variables correlated with $R_{t-1,t}$ and not controlled for in X impact areas with high and low stock market wealth uniformly. Importantly, we do *not* require that stock market wealth be distributed randomly. In fact, we show in Table B.4 that $S_{a,t}$ correlates with the share of a county's population with a college education and the median age, among other variables. Instead, as illustrated by Eq. (16), we require that high and low wealth areas not be heterogeneously affected by other aggregate variables that co-move with stock returns. This insight motivates our baseline specification and the robustness analysis below.

4.2 Baseline Specification

Our baseline specification implements Eq. (15) at the county level and at quarterly frequency, with outcome y either log employment or log quarterly payroll. We include the following controls in $X_{a,t-1}$: a county fixed effect, a state $\times$ quarter fixed effect, eight lags of the "shock" variable $\{S_{a,t-j-1}R_{t-j-1,t-j}\}_{j=1}^{8}$, and a measure of predicted employment growth at horizon h based only on industry composition, $\Delta_{a,t-1,t+h}e^B$. Thus, the specification utilizes only

of column t and zeros elsewhere, $\boldsymbol{R}$ the $T \times 1$ vector of stock market returns, $\boldsymbol{X}$ the $AT \times K$ matrix of Kcovariates stacked over areas and time periods, and $\boldsymbol{\epsilon}$ the $AT \times 1$ stacked vector of $\epsilon_{a,t-1,t+h}$. Then we can rewrite Eq. (15) in matrix form as:

$$\boldsymbol{Y} = \beta_h \boldsymbol{S}\boldsymbol{R} + \boldsymbol{X}\Gamma_h + \boldsymbol{\epsilon}.$$

It follows that $plim\hat{\beta}_h = \beta_h$ if

$$0 = \lim_{A,T\to\infty} (\boldsymbol{S}\boldsymbol{R})' \ \boldsymbol{\epsilon} = \lim_{A,T\to\infty} \boldsymbol{R}'\boldsymbol{S}'\boldsymbol{\epsilon} = \lim_{A,T\to\infty} \sum_t R_{t-1,t} \sum_a S_{a,t-1}\epsilon_{a,t-1,t+h} = E\left[R_{t-1,t}\mu_t\right].$$

within-state variation in stock market wealth and controls directly for the small correlation with lagged stock returns shown in Figure 2a through the lags of the shock variable. Following Bartik (1991), industry shift-share predicted employment growth between $t-1$ and $t+h$ is defined as $\Delta_{a,t-1,t+h}e^B = \sum_{i \in \text{NAICS 3}} \left(\frac{E_{a,i,t-1}}{E_{a,t-1}}\right)\left(\frac{E_{i,t+h}-E_{i,t-1}}{E_{i,t-1}}\right)$, where $E_{a,i,t}$ denotes the (seasonally unadjusted) level of employment in NAICS 3-digit industry i in county a and period t, $E_{a,t}$ is total employment in county a, and $E_{i,t}$ is seasonally-adjusted total national employment in industry i. This variable controls for exposure to national industry shifts which may correlate with stock returns and absorbs residual variation in the main outcomes. We weight regressions by 2010 population and report standard errors two-way clustered by time and county. Clustering by county accounts for any residual serial correlation in stock market returns and has a small effect on the standard errors in practice. Clustering by time allows for areas with high or low stock market wealth to experience other common shocks and accords with the recommendation of Adão et al. (2018) in the special case of a single national shifter.

4.3 Threats to Identification

Combining the criterion in Eq. (16) with our baseline specification, we can restate our identifying assumption as follows: following a positive stock return, areas with high stock market wealth relative to labor income do not experience unusually rapid employment or payroll growth—relative to their own mean and to other counties in the same state, and conditional on their industrial composition—for reasons other than the wealth effect on local consumption expenditure. As emphasized by Goldsmith-Pinkham et al. (2018), this requirement mirrors the parallel trends assumption in a continuous difference-in-difference design with multiple treatments. Two main threats to identification exist.

The first threat occurs because stock prices are forward-looking, so fluctuations in the stock market may reflect news about deeper economic forces such as productivity growth that independently affect consumption and investment. This "leading indicator" channel confounds interpretation of the relationship between consumption and the stock market in aggregate time series data. Our cross-sectional research design makes immediate progress by requiring only the weaker condition that high and low stock wealth areas not load differently on other aggregate variables that co-move with the stock market. Moreover, while we motivated the normalization of stock wealth by labor income to facilitate the mapping between the empirical analysis and the model, this normalization means that we do not simply compare wealthy and poor areas but rather areas that differ in their ratio of stock market to human capital wealth.

The control variables further weaken the exogeneity condition. In the baseline specification, county fixed effects absorb general trends which may differ across high and low wealth areas (for example, due to population growth). State $\times$ quarter fixed effects allow for loadings on other aggregate factors to vary by geographic state. Bartik employment growth allows for high wealth areas to concentrate in industries with higher stock market betas than those in low wealth areas or for certain industries to drive the stock market return and concentrate in high wealth areas, all without violating the identifying assumption. We show in robustness exercises that our results do not depend on these controls and are robust to finer controls such as commuting zone $\times$ quarter fixed effects. Furthermore, we exploit the substantial variation in stock returns that occurs independent of other aggregate variables (see Figure 2c) and report specifications that control directly for the interaction of stock market wealth with other macroeconomic variables such as TFP growth, interest rate changes, and GDP growth.

The second threat to identification concerns the separation of a consumption wealth effect from firm investment or hiring responding directly to the change in the cost of equity financing. Indeed, the response of total national employment to an increase in the stock market cannot separately identify these two channels. Our local labor market analysis absorbs changes in the cost of issuing equity common across areas into the time fixed effect. Nonetheless, firms in high stock wealth areas may have a cost of capital more sensitive to the value of the stock market. Two aspects of our research design make such a correlation an unlikely driver of our results: (i) we find an employment response in nontradable but not in tradable industries, so differential access to capital markets would have to occur within areas and align with the tradable/nontradable sectoral distinction, and (ii) in robustness exercises we control for the interaction of the stock market return with the share of payroll in a county at establishments belonging to large (500+ employee) firms, as these firms are more likely to have access to public capital markets.

5 Results

5.1 Baseline Results

In this section we report our baseline results: (i) an increase in the stock market causes faster employment and payroll growth in counties with higher stock market wealth, (ii) the response is pronounced in industries that produce nontradable goods and in residential construction, and (iii) there is no increase in employment in industries that mostly produce tradable goods.

Figure 3 reports the time paths of responses of quarterly employment and payroll to an increase in stock market wealth; formally, the coefficients β_h from estimating Eq. (15). Table 1 reports the corresponding coefficients and standard errors for $h = 7$, where the stock market return occurs in period 0. Because the stock market is close to a random walk (Figure 2b), these time paths should be interpreted as the dynamic responses to a permanent change in stock market wealth. Panel A of Figure 3 shows no pre-trends in either total employment or payroll, consistent with the parallel trends assumption. Both series start increasing in period 1. Payroll responds more than employment, reflecting either rising hours per employee or rising compensation per hour. The point estimates indicate that a rise in stock market wealth in quarter t equivalent to 1% of labor income increases employment by 0.0069 log point (i.e. an approximately 0.69 basis point increase) and payroll by 0.0225 log point in quarter $t + 7$. The increases appear persistent.

Panels B and C examine the responses in industries classified as producing nontradable or tradable output, respectively. Employment in nontradable industries rises by more than the total effect. In contrast, the employment response in tradable industries is flat following a positive stock market return. The horizon 7 difference between the tradable and nontradable employment coefficients is significant at the 5% level. The rise in employment in nontradable industries and flat response in tradable industries accords with the predictions of the theoretical model. It also militates against a leading indicator or cost-of-capital explanation since such confounding forces would have to apply only to the nontradable sector.

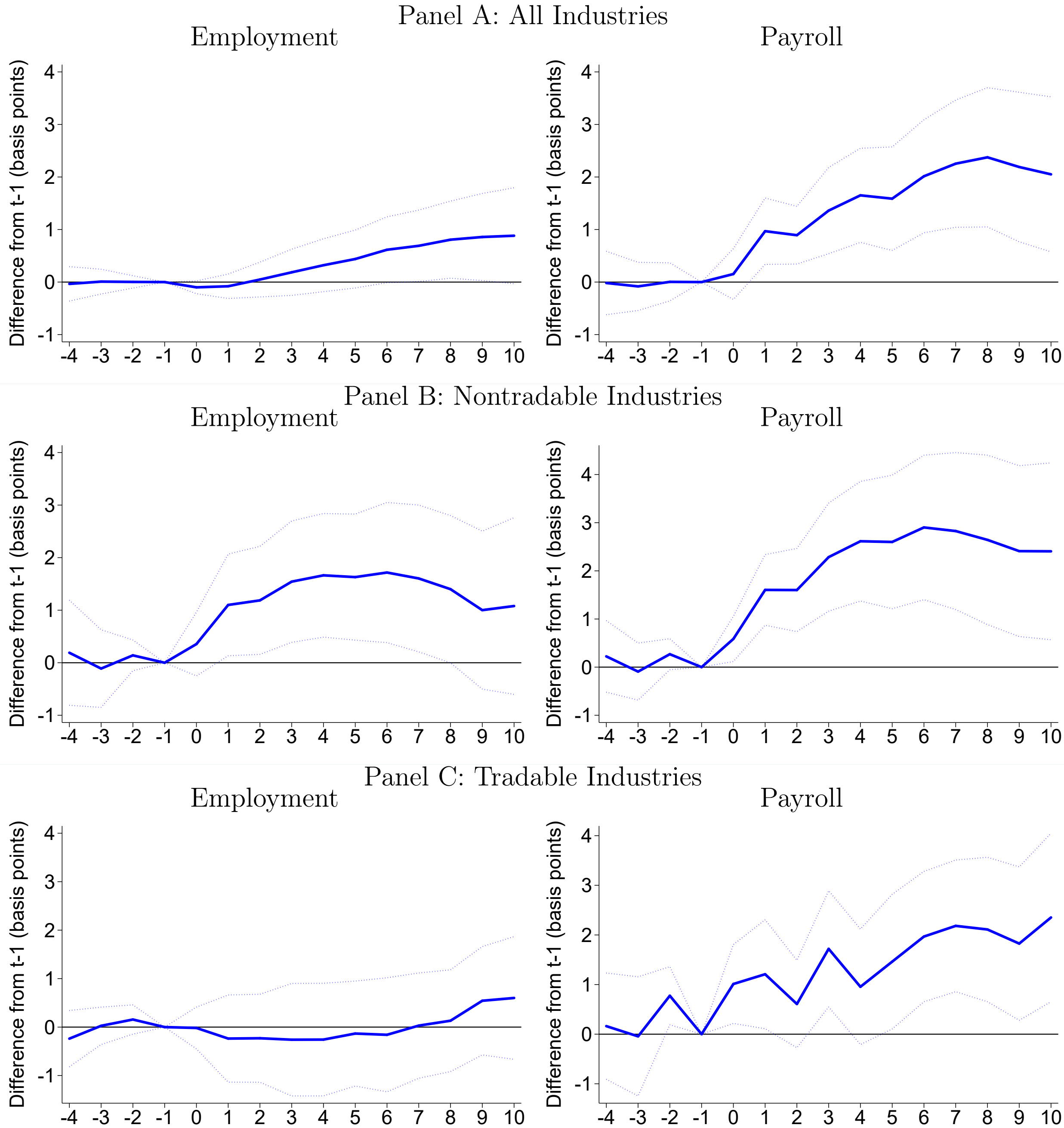
Figure 4 shows a large response of employment and payroll in the residential building construction sector (NAICS 2361). We show this sector separately because, while it also produces output consumed locally, the magnitude does not easily translate into our theoretical model since the sector produces a capital good (housing) that provides a service flow over many years. Thus, a desire by local residents to increase their consumption of housing services following a positive wealth shock will result in a front-loaded response of employment in the construction sector. Nonetheless, the large response of residential construction provides additional evidence of a local demand channel at work. We find no corresponding response in construction sectors unrelated to residential building.[18]

Figure 5 reports the (non-)response of population to an increase in wealth.[19] Population

[18]Figure B.3 reports smaller but statistically significant positive responses in specialty trade contractors (NAICS 238), a category that includes a number of sectors (electrical contractors, plumbers, etc.) involved in the construction of residential buildings. The figure also shows positive but delayed responses in non-residential building construction (NAICS 2362), possibly reflecting non-residential building construction firms engaging in some residential construction to meet the higher local demand. In contrast, there is a flat response in heavy and civil engineering construction (NAICS 237). In unreported results, we also find a large and statistically significant response of new building permits using the Census Bureau residential building permits survey.

[19]The population data by county come from the Census Bureau. The Census reports population as of

Figure 3: Baseline Results



Notes: The figure reports the coefficients β_h from estimating Eq. (15) for quarterly employment (left panel) and wages (right panel) at each quarterly horizon h shown on the lower axis. Panel A includes all covered employment and payroll; Panel B includes employment and payroll in NAICS 44-45 (retail trade) and 72 (accommodation and food services); Panel C includes employment and payroll in NAICS 11 (agriculture, forestry, fishing and hunting), NAICS 21 (mining, quarrying, and oil and gas extraction), and NAICS 31-33 (manufacturing). The shock occurs in period 0 and is an increase in stock market wealth equivalent to 1% of annual labor income. The dashed lines show the 95% confidence bands based on standard errors two-way clustered by county and quarter.

July 1 of each year. We linearly interpolate these data to obtain a quarterly series.

Table 1: Baseline Results

	All		Non-traded		Traded	
	Emp.	W&S	Emp.	W&S	Emp.	W&S
	(1)	(2)	(3)	(4)	(5)	(6)
Right hand side variables:						
$S_{a,t-1}R_{t-1,t}$	0.69*	2.25**	1.60*	2.83**	0.03	2.18**
	(0.35)	(0.62)	(0.71)	(0.83)	(0.55)	(0.68)
Bartik predicted employment	0.86**	1.46**	0.57**	0.81**	1.66**	2.13**
	(0.08)	(0.14)	(0.10)	(0.10)	(0.19)	(0.24)
Horizon h	Q7	Q7	Q7	Q7	Q7	Q7
Population weighted	Yes	Yes	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes	Yes	Yes
State×time FE	Yes	Yes	Yes	Yes	Yes	Yes
Shock lags	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.65	0.63	0.38	0.48	0.35	0.35
Counties	3,064	3,064	3,058	3,058	3,038	3,038
Periods	93	93	93	93	93	93
Observations	282,837	282,837	280,206	280,206	269,675	269,675

Notes: The table reports coefficients and standard errors from estimating Eq. (15) for $h = 7$. Columns (1) and (2) include all covered employment and payroll; columns (3) and (4) include employment and payroll in NAICS 44-45 (retail trade) and 72 (accommodation and food services); columns (5) and (6) include employment and payroll in NAICS 11 (agriculture, forestry, fishing and hunting), NAICS 21 (mining, quarrying, and oil and gas extraction), and NAICS 31-33 (manufacturing). The shock occurs in period 0 and is an increase in stock market wealth equivalent to 1% of annual labor income. For readability, the table reports coefficients in basis points. Standard errors in parentheses and double-clustered by county and quarter. * denotes significance at the 5% level, and ** denotes significance at the 1% level.

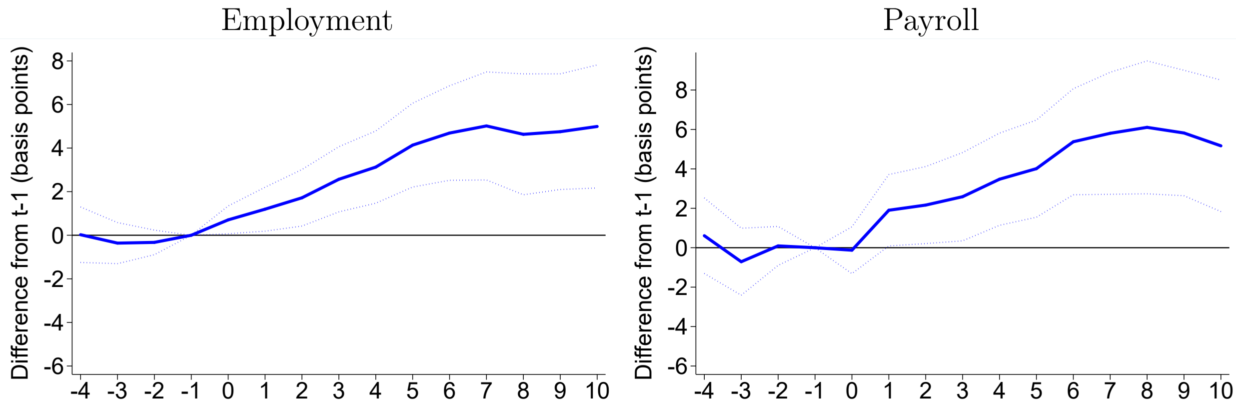
inflows do not explain the increase in local employment when stock market wealth rises.

5.2 Robustness

Tables 2 and 3 report results from a number of robustness exercises for total and nontradable employment and payroll for the horizon $h = 7$. The first row of each table reproduces the baseline specification.

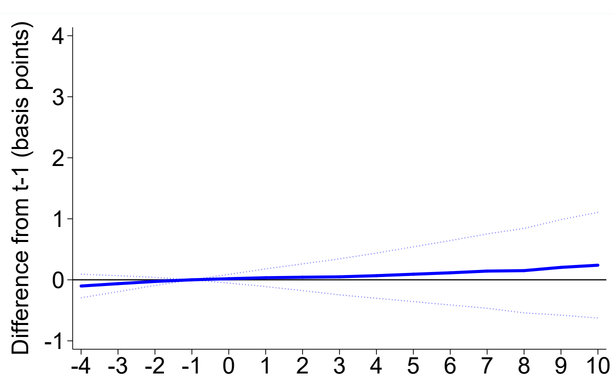
Table 2 shows robustness to subtracting or adding covariates to the baseline specification. Rows 2 and 3 expand the variation used to identify the response by removing the Bartik control and using quarter rather than state-by-quarter fixed effects. The results are similar to the baseline specification.

Figure 4: Response of Residential Construction



Notes: The figure reports the coefficients β_h from estimating Eq. (15) for residential building construction (NAICS 2361) employment and payroll at each quarterly horizon h shown on the lower axis. The shock occurs in period 0 and is an increase in stock market wealth equivalent to 1% of annual labor income. The dashed lines show the 95% confidence interval bands.

Figure 5: Response of Population



Notes: The figure reports the coefficients β_h from estimating Eq. (15) for total county population at each quarterly horizon h shown on the lower axis. The shock occurs in period 0 and is an increase in stock market wealth equivalent to 1% of annual labor income. The dashed lines show the 95% confidence interval bands.

Rows 4 to 6 add interactions of wealth $S_{a,t-1}$ and changes between $t-1$ and $t+h$ in aggregate log utilization-adjusted TFP, the short-term interest rate, and log GDP, respectively, to the baseline specification. Controlling for interactions of other aggregate variables with $S_{a,t-1}$ amounts to using only the variation in $R_{t-1,t}$ that is orthogonal to these other variables. In our application, these interactions address directly the possibility that the period t stock return forecasts changes in other aggregate variables that high and low wealth areas load on differentially. Interacting with TFP addresses the concern that a positive stock market return forecasts future TFP growth, as in theories of news-driven business cycles (Beaudry and Portier, 2006), which could have a more pronounced impact on firms or workers in high wealth areas. Interacting with changes in interest rates addresses the concern that high and

Table 2: Robustness to Covariates

Dependent variable:	Total emp.	Total payroll	Nontradable emp.	Nontradable payroll
Specification:				
Baseline	0.69*	2.25**	1.60*	2.83**
	(0.35)	(0.62)	(0.71)	(0.83)
Only county & state×quarter FE	1.07**	2.91**	1.56+	3.05**
	(0.38)	(0.69)	(0.81)	(0.92)
Only county & quarter FE	1.10*	2.78**	1.43+	2.84**
	(0.48)	(0.85)	(0.84)	(1.03)
TFP sensitivity	0.62+	2.23**	1.21*	2.52**
	(0.33)	(0.60)	(0.59)	(0.74)
Interest rate sensitivity	0.70*	1.67**	0.97+	1.90**
	(0.34)	(0.54)	(0.57)	(0.61)
GDP sensitivity	0.71+	1.65**	1.81*	2.47**
	(0.38)	(0.60)	(0.78)	(0.84)
Control house prices	0.60+	2.18**	1.13*	2.41**
	(0.34)	(0.62)	(0.52)	(0.73)
Control large firm share	0.62+	2.13**	1.52*	2.69**
	(0.33)	(0.58)	(0.66)	(0.77)
Control lagged outcomes	0.69*	2.23**	1.63*	2.75**
	(0.34)	(0.60)	(0.72)	(0.82)
CzoneXtime FE	0.65	2.07**	1.83+	2.94**
	(0.46)	(0.67)	(1.00)	(1.04)

Notes: The table reports alternative specifications to the baseline for $h = 7$. The shock occurs in period 0. Each cell reports the coefficient and standard error from a separate regression with the dependent variable indicated in the table header and the specification described in the left-most column. For readability, the table reports coefficients in basis points. Standard errors in parentheses and double-clustered by county and quarter. + denotes significance at the 10% level, * denotes significance at the 5% level, and ** denotes significance at the 1% level.

low stock wealth areas may also differ in their fixed income wealth.[20] The GDP interaction allows for any differential cyclicality of high and low wealth areas and could *over*-control if, unlike in our model, aggregate GDP itself responds to the stock price change through a consumption wealth effect. We find small changes in the coefficients in each of these spec-

[20]Different fixed income wealth matters here only insofar as changes in the value of fixed income—due primarily to changes in interest rates—correlate with our main regressor. Therefore, interacting changes in the interest rate with stock wealth directly amounts to allowing for an arbitrary correlation between the levels of stock wealth and fixed income wealth.

ifications. The insensitivity reflects a combination of two forces: (i) the loadings on these other variables do not vary too much with wealth, and (ii) as illustrated in Figure 2c, while stock prices are not strictly exogenous, much of the volatility in the stock market and hence the variation in our main regressor occurs for reasons unrelated to economic fundamentals.

Rows 7-10 add local controls to the baseline specification. Row 7 controls for contemporaneous and 12 lags of local house prices to ensure our results do not confound comovement of housing wealth with stock market wealth.[21] Row 8 controls for the share of payroll in a county at establishments belonging to large (500+ employee) firms interacted with the stock market return.[22] Large firms are more likely to have publicly traded equity and thus experience a direct reduction in their cost of capital when the stock market rises; the stability of coefficients indicates that our results do not reflect an investment response by such firms. Row 9 includes lagged outcomes to control directly for any pre-trends.[23] Row 10 replaces the state-by-quarter fixed effects with commuting zone-by-quarter fixed effects. In this specification, identification comes from comparing the responses of high and low wealth counties within the same commuting zone. Adding these controls has a minor effect on the point estimates.

Table 3 collects other robustness exercises. Rows 2 and 3 show qualitatively similar responses in the first half (1990-2003) and second half (2004-2017) of the sample. Row 4 trims the top and bottom 1% of $S_{a,t}$ per quarter. The point estimates uniformly rise without these very high and low wealth counties.

Row 5 excludes counties in which at least one S&P 500 constituent firm (current or historical since 1962) has had its headquarters, while row 6 excludes counties in which a firm on the Forbes list of the largest private companies have their headquarters. These results show that our findings are not driven by an increase in labor income compensation of managers of large corporations in response to an increase in stock prices.

Row 7 excludes the quarters with the 5% largest and smallest stock returns with little effect on the results. Row 8 reports similar responses in unweighted regressions which exclude

[21] We use the Federal Housing Finance Agency (FHFA) annual county-level repeat sales house price index and interpolate to obtain a quarterly series. In unreported results, we also find the response of residential construction remains quantitatively robust to controlling for contemporaneous and lags of house price growth so that the construction response does not merely reflect a run-up in local house prices in high wealth areas before the stock market rises.

[22] Data on payroll by firm size come from the Census Bureau's Quarterly Work Force Indicators. Because this data set has less historical coverage than our baseline sample, we use the time series mean share for each county. This step contains little loss of information because the large payroll share is extremely persistent at the county level, with an R^2 of 0.85 from a regression of the quarterly large share on a full set of county fixed effects.

[23] We include both a county fixed effect and lags of the dependent variable because of the large time dimension (roughly 100 quarters) of the data (Alvarez and Arellano, 2003).

very small counties (fewer than 20,000 residents) while row 9 shows that the results are not driven by the largest 1% of counties. Row 10 shows that using employment and payroll from the Census Bureau's Quarterly Work Force Indicators yields coefficients of similar magnitude but larger standard errors.

The next three rows alter the shock variable. Row 11 uses only the price component of the S&P 500 return with similar results. Row 12 uses the within-county mean ratio of dividend income to labor income in $S_{a,t-1}$ so that variation in this variable reflects only variation in the aggregate dividend-price ratio. Because the dividend-labor income ratio changes little over time, fixing this ratio has little effect on the results. Row 13 imputes total county stock wealth (including retirement wealth) using county demographic characteristics such as age and education along with the value of non-retirement stock wealth, based on the relationship among these variables in the Survey of Consumer Finances (see Appendix B.5 for details.) As discussed further in Section 3.1, most stock wealth and most of the variation in stock wealth is held in taxable accounts, and the results change little with this imputation. Finally, while our baseline specification normalizes dividend wealth by labor income, row 14 shows that we obtain similar results using dividend wealth per tax return instead.

The last row returns to the baseline specification but expands the geographic unit to a Core Based Statistical Area (CBSA).[24] The point estimates rise slightly and the standard errors substantially, although 3 of the 4 coefficients remain significant at the 5% level. The larger standard errors reflect the decrease in wealth variation after averaging across counties within a CBSA and the smaller sample size. The larger coefficients could reflect spending that occurs outside of a resident's county but within the CBSA; however, the data do not reject equality of the coefficients in the county and CBSA specifications.

5.3 Decomposing Variation

In this section we provide evidence on which areas "drive" the results in the sense of Andrews et al. (2017). Consider the specification reported in row 2 of Table 2 in which $X_{a,t}$ includes only a county fixed effect and state-by-quarter fixed effect. In this case, letting $\tilde{z}_{a,t}$ denote $S_{a,t-1}R_{t-1,t}$ demeaned by county and state-by-quarter, $\Delta_{a,t}\tilde{y}$ the outcome after demeaning with respect to county and state-by-quarter (where for notational simplicity we have sup-

[24]The Office of Management and Budget (OMB) defines CBSAs as areas "containing a large population nucleus and adjacent communities that have a high degree of integration with that nucleus" and has designated 917 CBSAs of which 381 (covering 1,166 counties) are Metropolitan Statistical Areas (MSAs) and the remainder (covering 641 counties) are Micropolitan Statistical Areas (MiSAs). An MSA is a CBSA with an urban core of at least 50,000 people. The remaining counties not affiliated with a CBSA are rural and excluded from the estimation. Because CBSA's may contain counties from multiple states (e.g. the Boston-Cambridge-Newton MSA contains five counties in MA and two counties in NH), the specification in this row replaces the state×quarter fixed effects with quarter fixed effects.

Table 3: Other Robustness

Dependent variable:	Total emp.	Total payroll	Nontradable emp.	Nontradable payroll
Specification:				
Baseline	0.69^{*}	2.25^{**}	1.60^{*}	2.83^{**}
	(0.35)	(0.62)	(0.71)	(0.83)
1990-2003	0.25	2.08^{**}	2.27^{*}	2.70^{*}
	(0.33)	(0.61)	(1.00)	(1.13)
2004-2017	1.55^{*}	2.73^{*}	1.60^{*}	3.52^{*}
	(0.65)	(1.33)	(0.73)	(1.38)
Trim top/bottom 1% of $S_{a,t}$	1.02^{+}	3.33^{**}	2.56^{*}	4.57^{**}
	(0.56)	(0.92)	(1.27)	(1.33)
Drop S&P 500 HQs	0.38	1.05^{*}	1.62^{*}	2.14^{**}
	(0.28)	(0.51)	(0.80)	(0.72)
Drop Forbes Top Private HQs	0.33	1.05^{*}	1.76^{*}	2.61^{**}
	(0.23)	(0.48)	(0.87)	(0.87)
Keep if $R_{t-1,t} \in [P5, P95]$	0.72	2.08^{*}	2.21^{*}	3.36^{**}
	(0.45)	(0.81)	(1.00)	(1.12)
Unweighted, population$> 20,000$	0.61^{+}	1.51^{**}	2.34^{*}	2.94^{**}
	(0.34)	(0.53)	(1.13)	(0.88)
Trim by population	0.74^{*}	2.14^{**}	1.90^{*}	2.96^{**}
	(0.33)	(0.66)	(0.83)	(0.89)
QWI	0.96^{*}	2.30^{**}	1.02^{*}	2.29^{**}
	(0.48)	(0.72)	(0.43)	(0.75)
Price component only	0.68^{+}	2.25^{**}	1.60^{*}	2.83^{**}
	(0.35)	(0.62)	(0.71)	(0.83)
Fix dividends/income	0.77^{*}	2.54^{**}	1.57^{*}	2.73^{**}
	(0.34)	(0.64)	(0.74)	(0.89)
Imputed total equity	0.57^{+}	1.97^{**}	1.37^{*}	2.45^{**}
	(0.31)	(0.54)	(0.63)	(0.73)
Wealth per return	1.23^{**}	3.32^{**}	1.77^{**}	3.49^{**}
	(0.38)	(0.93)	(0.66)	(0.95)
Across CBSAs	0.78	2.81^{*}	2.85^{*}	3.97^{*}
	(0.63)	(1.20)	(1.31)	(1.66)

Notes: The table reports alternative specifications to the baseline for $h = 7$. The shock occurs in period 0. Each cell reports the coefficient and standard error from a separate regression with the dependent variable indicated in the table header and the specification described in the left-most column. For readability, the table reports coefficients in basis points. Standard errors in parentheses and double-clustered by county and quarter. + denotes significance at the 10% level, * denotes significance at the 5% level, and ** denotes significance at the 1% level.

pressed the dependence of Δ on the horizon h), π_a the 2010 population in county a, and s index states, we can decompose the OLS coefficient as follows:

$$\beta = \sum_s w_s \beta_s$$

$$\text{where} \qquad \beta_s \equiv \left(\sum_{a \in s} \sum_t \pi_a \tilde{z}_{a,t}^2 \right)^{-1} \sum_{a \in s} \sum_t \pi_a \tilde{z}_{a,t} \Delta_{a,t} \tilde{y},$$

$$w_s \equiv \left(\sum_{a'} \sum_t \pi_{a'} \tilde{z}_{a',t}^2 \right)^{-1} \left(\sum_{a \in s} \sum_t \pi_a \tilde{z}_{a,t}^2 \right).$$

Here, β_s is the regression coefficient obtained by using only observations from state s and the weight w_s is the contribution to the total (residual) variation in the regressor from state s.[25] The weights $\{w_s\}$ are all positive and sum to one.

Table 4 reports the ten states with the largest weight in the regression. Not surprisingly, since the regression weights by population, the four states with the largest populations — California, Texas, New York, and Florida — rank among the five states with the highest weights. More surprisingly, Florida, with 6% of the 2010 population, has a weight in the regression above 40%. This high share reflects the large variation across Florida counties in stock market wealth. On the other hand, Florida does *not* drive the finding of a positive regression coefficient, as the Florida-only nontradable labor bill coefficient is *smaller* than the overall coefficient. Hence excluding Florida from the sample would *raise* the estimated coefficient. Virginia also receives a larger weight in the regression than its population share, reflecting the contrast in the state between wealthier northern suburbs of D.C. and poorer southern counties. Notably, all 10 of the states with the largest weight (and 45 of 50 states overall) have $\beta_s > 0$. Thus, no one or two states drive the overall result.

5.4 Heterogeneity

This section reports heterogeneity of the response by per capita wealth. Many theories of consumption predict higher MPCs for less wealthy households. In the context of stock market wealth, Di Maggio et al. (2018) find a higher MPC in Sweden among households in the lower half of the wealth distribution.

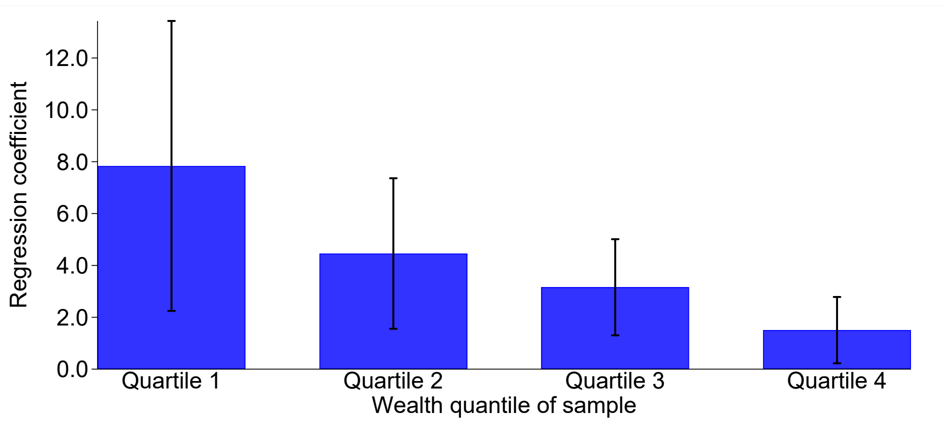
We start by taking a time average within each state of real (deflated by the price index for personal consumption expenditure) dividends per person and then sort states along this

[25] We could have done this decomposition for the baseline specification after partialing out the Bartik variable. In that case, the coefficient β_s would no longer equate to the coefficient from estimating the regression in state s only because the coefficient on the Bartik term would differ across states.

Table 4: Ten States with Largest Weight

State	Population share	Weight	β_s, nontradable wage bill
Florida	0.061	0.423	0.616
California	0.121	0.074	5.487
Texas	0.081	0.040	7.476
Virginia	0.026	0.034	3.583
New York	0.063	0.031	3.054
Georgia	0.031	0.025	1.158
Pennsylvania	0.041	0.025	0.179
Washington	0.022	0.023	6.729
Ohio	0.037	0.023	1.816
North Carolina	0.031	0.023	5.470

Figure 6: Heterogeneity by Wealth



Notes: The figure reports the coefficients β_h from estimating Eq. (15) for the nontradable wage bill at horizon $h = 7$, separately for states in each quartile of the per capita wealth distribution. The whiskers show the 95% confidence intervals.

dimension into four quartiles of per capita wealth. We then estimate the baseline specification separately for each quartile of states.[26] Figure 6 reports the results, focusing on the labor bill response in nontradable industries. As shown in the following section, this coefficient relates most directly to the household-level MPC out of stock wealth.

The figure shows a response of the nontradable labor bill that declines monotonically with

[26]The quartiles are: Alabama, Arkansas, Idaho, Indiana, Kentucky, Louisiana, Mississippi, New Mexico, North Dakota, Oklahoma, Tennessee, Utah, West Virginia (quartile 1); Alaska, Georgia, Hawaii, Iowa, Michigan, Nebraska, North Carolina, Ohio, Oregon, South Carolina, South Dakota, Texas, Wisconsin (quartile 2); Arizona, California, Colorado, Kansas, Maine, Minnesota, Missouri, Montana, New York, Pennsylvania, Rhode Island, Virginia, Wyoming (quartile 3); Connecticut, Delaware, Florida, Illinois, Maryland, Massachusetts, Nevada, New Hampshire, New Jersey, Vermont, Washington (quartile 4).

the average level of wealth among states in the sample. Among the least wealthy states, the point estimate equals 7.84, while for the wealthiest states the point estimate is 1.51. In all four subsamples these point estimates remain statistically significant at the 5% level. An equality test rejects equality of the response in the wealthiest quartile with the responses in the two least wealthy quartiles at the 5% level. These results reflect a combination of a consumption stock market wealth effect and general equilibrium amplification that decline with wealth.

6 Calibration

In this section, we use our empirical results from Section 5 to calibrate two key parameters from the theoretical model in Section 2: the strength of the direct stock wealth effect, $\frac{1}{1+\delta}$, and the degree of wage adjustment, κ. We only need two model equations to estimate these parameters. Therefore, our calibration also applies in richer models as long as these equations hold. Throughout, we choose the coefficients reported in Table 1 as our calibration targets. As shown in Figure 3, the first few quarters of the impulse response feature sluggish adjustment for reasons outside the model (e.g. consumer habit or delayed recognition of the stock wealth changes). By quarter 7 adjustment is complete and the effect is relatively stable thereafter.

6.1 Direct Stock Wealth Effect

To determine the stock wealth effect parameter, we consider the nontradable labor bill in the special case with $\varepsilon = 1$. To facilitate interpretation, we rewrite Eq. (11) as:

$$\begin{aligned} \Delta\left(w_{a,0} + l_{a,0}^N\right) &= \mathcal{M}\left(1-\alpha\right)\rho \times S_{a,0} R_0, \\ \text{where } \rho &= \frac{1}{T}\frac{1}{1+\delta} \text{ and } S_{a,0} = \frac{x_{a,0}Q_0}{\overline{WL}_0/T}, R_0 = \frac{\Delta Q_0}{Q_0}. \end{aligned} \tag{17}$$

Here, we have introduced the change of variables $\frac{1}{1+\delta} = \rho T$, where we interpret ρ as the stock market wealth effect *per year* and T as the length of period 0 in years. Thus, the denominator of $S_{a,0}$, $\frac{\overline{WL}_0}{T}$, equals the labor bill *per year* as in the empirical implementation, and the empirical coefficient maps into the stock wealth effect *per year*. In particular, the empirical coefficient can be decomposed into three terms: ρ, the partial equilibrium MPC out of stock market wealth, the labor share of income $1-\alpha$, and the local Keynesian multiplier (equivalent to the multiplier on local government spending) $\mathcal{M}$. We set the labor share to a value standard in the literature, $1-\alpha = 2/3$, and adjust other parameters to achieve a multiplier $\mathcal{M}$ =1.5, in line with empirical estimates (Nakamura and Steinsson, 2014; Chodorow-Reich, 2019).[27] We then calculate ρ by combining Eq. (17) with the empirical coefficient for the nontradable labor bill.

Specifically, using the coefficient from Table 1, we obtain:

$$\mathcal{M}(1-\alpha)\rho = \frac{\Delta\left(w_{a,0}+l_{a,0}^N\right)}{S_{a,0}R_0} = 2.83\%. \tag{18}$$

Substituting $1-\alpha = 2/3$ and $\mathcal{M}$ =1.5, yields

$$\rho = 2.83\%.$$

Hence, our estimates suggest that a one dollar increase in stock wealth increases household spending by about 2.83 cents per year (at a horizon of two years). The implied magnitude is in line with the yearly discount rates typically assumed in the literature. It is also close to the estimates of the stock wealth effect on consumption for wealthy households in Di Maggio et al. (2018), which uses detailed household-level data from Sweden.

We make three remarks on this approach. First, it does not depend on the labor supply block of the model. Second, we do not have to parameterize the share of nontradables in spending, η. To understand why, rewrite Eq. (17) as:

$$\frac{\Delta\left(W_{a,0}L_{a,0}^N/T\right)}{\overline{WL}_0^N/T}\frac{\overline{WL}_0^N}{T} = \mathcal{M}(1-\alpha)\rho\eta\left(x_{a,0}\Delta Q_0\right) \text{ where } \eta = \frac{\overline{WL}_0^N}{\overline{WL}_0}.$$

This expression illustrates that the effect of stock market wealth on the nontradable labor bill *in dollars*, $\Delta\left(W_{a,0}L_{a,0}^N/T\right)$, does depend on the share of nontradables in spending, η. However, with homothetic preferences and production across sectors, the nontradable labor bill as a fraction of the total labor bill is equal to the share of nontradables in spending, $\frac{\overline{WL}_0^N}{\overline{WL}_0} = \eta$. Therefore, since Eq. (17) normalizes the stock wealth change with the total labor bill, η drops out of the equation. Intuitively, with homothetic preferences these sectors' share in total spending (measured by their share of the labor bill) proxies for their share in

[27] To see how we calibrate the multiplier, note that the change of variables in (17) creates one free parameter, T. This parameter is not very meaningful since our model has stylized time periods (it has only two periods). The parameter affects the analysis mainly through its impact on the local multiplier, which is given by:

$$\mathcal{M} = \frac{1}{1-(1-\alpha)\eta/(1+\delta)} = \frac{1}{1-(1-\alpha)\eta\rho T}.$$

Therefore, we use T to calibrate the local multiplier as $\mathcal{M} = 1.5$ given all other parameters. We avoid a literal interpretation of T and view it as a stand in for other features, such as borrowing constraints, which would affect $\mathcal{M}$ in richer models (see Appendix A.6 for intuition about why T affects $\mathcal{M}$ in our model).

marginal spending. Since the decomposition in (17) does not depend on η, we can use it as long as we observe the response in a subset of nontradable sectors.

Third, when $\varepsilon \neq 1$, Eq. (17) applies up to an adjustment (see Eq. (11)). The adjustment reflects the possibility that the change in the tradable labor bill—due to the change in local wages—affects local households' income and creates knock-on effects on the nontradable labor bill. If wages are sufficiently rigid, then the tradable adjustment does not change the analysis by much even if ε is somewhat different from 1. In practice, the value we obtain for κ (described next) implies that there is little loss of generality in ignoring this adjustment for empirically reasonable levels of ε. Therefore, we adopt $\varepsilon = 1$ as our baseline calibration in the main text and relegate the more general case to the appendix.[28]

6.2 Wage Adjustment

We use Eq. (10) to determine the wage adjustment parameter κ,

$$\Delta l_{a,0} = \frac{1}{1+\kappa} \Delta \left(w_{a,0} + l_{a,0} \right) \ . \tag{19}$$

Recall that κ is a composite parameter that combines wage stickiness and labor supply elasticity [cf. Eq. (8)]. Therefore, it captures wage adjustment over the estimation horizon. One caveat is that, while the model makes predictions for total labor supply including changes in hours per worker, in the data we only observe employment. A long literature dating to Okun (1962) finds an elasticity of total hours to employment of 1.5. Applying this adjustment and using the coefficients for total employment and the total labor bill from Table 1 yields:

$$\begin{aligned} \frac{\Delta l_{a,0}}{S_{a,0} R_0} &= 1.5 \times 0.69\% \\ \frac{\Delta \left(w_{a,0} + l_{a,0} \right)}{S_{a,0} R_0} &= 2.25\%. \end{aligned}$$

Combining these with Eq. (19), we obtain:

$$\kappa = 1.2. \tag{20}$$

[28]Specifically, in Appendix A.6.2 we consider alternative calibrations with $\varepsilon = 0.5$ and $\varepsilon = 1.5$. In these cases, since trade adjustment affects the analysis, the implied ρ also depends on the share of tradables, η. We allow this parameter to vary over a relatively large range, $\eta \in [0.5, 0.8]$, and show that the implied ρ remains within 10% of its baseline level. As expected, the greatest deviations from the baseline occur when η is low (that is, when the area is more open).

Thus, a one percent change in labor is associated with a 1.2% change in wages at a horizon of two years.[29]

7 Aggregation

We next describe the effect of stock market changes on *aggregate* outcomes. In our model so far, these effects appear only in the interest rate ("rstar") because monetary policy adjusts to ensure aggregate employment remains at the frictionless level. We now consider an alternative scenario in which monetary policy is passive and leaves the interest rate unchanged in response to changes in stock prices. In this case, stock wealth changes affect aggregate labor market outcomes.

Our aggregation result for the labor bill is straightforward and relies on two observations. First, given homothetic preferences and production across sectors, a one dollar increase in stock market wealth has the same *proportional* effect on the *aggregate total* labor bill and the *local nontradable* labor bill, up to an adjustment for the difference in the aggregate and local spending multipliers. Second, since the aggregate spending multiplier is greater than the local multiplier, we can bound the aggregate effect from below. Therefore, our empirical estimate of the effect on the local nontradable labor bill is a lower bound for the effect on the aggregate total labor bill.

Our aggregation result for labor combines this finding with a third observation: since labor markets are local, the structural labor supply equation (4) remains unchanged as we switch from local to aggregate analysis (as emphasized by Beraja et al. (2016)). The reduced form labor supply equation in (8) changes slightly because shocks impact aggregate inflation and local inflation differently.

To establish these results formally, consider the model from Section 2, but assume that monetary policy keeps the nominal interest rate at a constant level, $R^f = \overline{R}^f$.[30] Appendix A.7 extends our theoretical analysis to this case. The aggregate equilibrium with a fixed interest rate is described by the tuple, (Q_0, L_0, W_0, P_0), that solves four equations provided in Appendix A.7. These equations illustrate that changes in the expected productivity of capital, D_1, affect not only the price of capital—as in the baseline model—but also aggregate income, employment, wages, and prices.

[29] We can also estimate κ from the response of tradable employment [cf. Eq. (A.66)]. Intuitively, tradable employment declines only insofar as local wages and prices rise, so the response of l^T provides information about κ. Auclert et al. (2019) implement this approach in a different empirical setting. We prefer not to rely on this relationship because in practice (unlike in our model) even tradable goods may be influenced by local demand due to home bias, non-zero transportation costs, and supply chains. Nonetheless, the flat response of employment in the industries we classify as tradable in the data accords with a low value of κ.

[30] As before, monetary policy stabilizes the long-run wage level at the constant level, $\overline{W}$.

To characterize these effects further (and to compare them with their local equilibrium counterparts), we log-linearize the equilibrium around the frictionless benchmark. Specifically, we let $\overline{D}_1$ denote the level of capital productivity such that $\overline{R}^f = R^{f,*}$ given $\overline{D}_1$. Considering the equilibrium variables as a function of D_1, and log-linearizing around $D_1 = \overline{D}_1$, we obtain the following equations for the aggregate labor bill and labor:

$$\Delta \left(w_0 + l_0\right) = \mathcal{M}^A \left(1-\alpha\right) \frac{1}{1+\delta} \frac{\Delta Q_0^A}{\overline{WL_0}}, \tag{21}$$

$$\Delta l_0 = \frac{1}{1+\kappa^A} \Delta \left(w_0 + l_0\right), \tag{22}$$

$$\text{where } \mathcal{M}^A \equiv \frac{1}{1 - 1/\left(1+\delta\right)} \frac{1+\kappa^A}{1-\alpha+\kappa^A}$$

$$\text{and } \kappa^A \equiv \frac{\lambda\varphi}{1-\lambda}.$$

Here, $l_0 = \log\left(L_0/\overline{L}_0\right)$ and $w_0 = \log\left(W_0/\overline{W}\right)$ denote log deviations of aggregate employment and wages from the frictionless benchmark. The variable Q_0^A is the log-linear approximation to the exogenous part of stock wealth, $\frac{\overline{W}D_1}{\overline{R}^f}$.[31] As before, $\Delta y \equiv y^{new} - y^{old}$ denotes the change in equilibrium variable y when expected future dividends change. Hence, Eqs. (21) and (22) describe the effect of a change in stock wealth on aggregate labor market outcomes. The parameter $\mathcal{M}^A$ captures the aggregate multiplier effects. The parameter κ^A captures the degree of aggregate wage adjustment.

Eq. (21) shows that the effect on the aggregate labor bill closely parallels its local counterpart (Eq. (10)), with three differences. First, the direct spending effect is greater in the aggregate than at the local level, $\frac{1-\alpha}{1-\delta} > \frac{1-\alpha}{1-\delta}\eta$. Intuitively, some spending falls on goods that are tradable across local areas but nontradable in the aggregate. Second, the aggregate labor bill does not feature the export adjustment term $\frac{1+\kappa}{1+\kappa\zeta}$. Third, the aggregate multiplier is greater than the local multiplier, $\mathcal{M}^A > \mathcal{M}$, because spending on tradables (as well as the mobile factor, capital) diminish the local but not the aggregate multiplier.[32]

[31] The stock price satisfies $Q_0 = W_0 D_0 + \frac{\overline{W}D_1}{\overline{R}^f}$. In this setting, a one dollar increase in $\frac{\overline{W}D_1}{\overline{R}^f}$ increases the equilibrium stock price, Q_0, by more than one dollar. This is because the increase in aggregate demand and output in period 0 also increases the rental rate of capital, $W_0 D_0$. We focus on the comparative statics for a one dollar change in the exogenous component of the stock wealth (as opposed to actual stock wealth) as the appropriate counterfactual scenario for what would happen if monetary policy did not react to an observed shock.

[32] The aggregate spending multiplier is captured by the term $\tilde{\mathcal{M}}^A \equiv \frac{1}{1-1/(1+\beta)}$, which exceeds the local multiplier $\mathcal{M} = \frac{1}{1-(1-\alpha)\eta/(1+\beta)}$. In our setting, there is also a second multiplier effect in the aggregate, captured by the term $\mathcal{F}^A \equiv \frac{1+\kappa^A}{1-\alpha+\kappa^A} > 1$. This effect emerges because demand-driven fluctuations in our model are absorbed by labor only. We refer to $\mathcal{F}^A$ as *the factor-share multiplier*. The composite multiplier, $\mathcal{M}^A = \mathcal{F}^A \tilde{\mathcal{M}}^A$, combines the standard spending multiplier with the factor-share multiplier. Our model

Likewise, Eq. (22) shows that the reduced-form labor supply equation closely parallels its local counterpart (cf. Eqs. (10) and (8)). In fact, since labor markets are local, the structural labor supply equation (4) that features prices and labor does not change as we switch from local to aggregate analysis. However, while the aggregate price level moves one-for-one with wages, $p_0 = w_0$, the price level for local consumption does not, since the price of tradable goods and capital are determined nationally, $p_{a,0} = w_{a,0}\eta(1-\alpha)$ [cf. Eq. (7)]. Therefore, the real wage $w - p$ responds locally but not in the aggregate. The real wage response generates a neoclassical local labor supply response, with strength determined by the magnitude of the Frish elasticity $1/\phi$, that does not extend to the aggregate level. Rewriting the expressions for κ and κ^A to eliminate the wage stickiness parameter, λ, we obtain:

$$\frac{1}{\kappa} = \frac{1}{\varphi}\left(1-\eta\left(1-\alpha\right)\right) + \frac{1}{\kappa^A}. \tag{23}$$

This expression illustrates that the local labor response, $\frac{1}{\kappa}$, combines a neoclassical response to higher real wages, $\frac{1}{\varphi}\left(1-\eta\left(1-\alpha\right)\right)$, that only occurs locally, and a term due to wage stickiness that extends to the aggregate, $\frac{1}{\kappa^A}$.

We now use our estimates for the local effects to quantify the aggregate effects on the labor market. We first use Eq. (21) to quantify the effect on the aggregate labor bill. Using the change of variables, $\frac{1}{1+\delta} = \rho T$, we rewrite this equation as follows:

$$\begin{aligned} \Delta\left(w_0 + l_0\right) &= \mathcal{M}^A\left(1-\alpha\right)\rho \times S_0^A R_0^A \\ \text{where } S_0^A &= \frac{Q_0^A}{\overline{WL}_0/T} \text{ and } R_0^A = \frac{\Delta Q_0^A}{Q_0^A}. \end{aligned} \tag{24}$$

We define S^A as the ratio of aggregate stock wealth to the aggregate yearly labor bill, and R^A as the shock to stock valuations. Hence, $S_0^A R_0^A$ is the aggregate analog of $S_{a,0}R_0$ from the local analysis.

The coefficient in Eq. (24) is the same as its local counterpart in Eq. (17) for the *local nontradable* labor bill, up to an adjustment for the differences in the local and aggregate spending multipliers. Hence, we can combine our estimate for the local nontradable labor bill (for quarter 7) with the inequality $\frac{\mathcal{M}^A}{\mathcal{M}} \geq 1$ to bound the coefficient from below:

$$\mathcal{M}^A\left(1-\alpha\right)\rho = 2.83\%\frac{\mathcal{M}^A}{\mathcal{M}} \geq 2.83\%.$$

Therefore, if not countered by monetary policy, a one dollar increase in stock valuations

is too stylized to provide an exact mapping between the local and aggregate multipliers. The inequality $\frac{\mathcal{M}^A}{\mathcal{M}} \geq 1$ is a robust feature of settings with constrained monetary policy (Chodorow-Reich, 2019).

increases the aggregate labor bill per year by at least 2.83 cents. Why does the effect on the *local nontradable* labor bill provide information about the implied effect on the *aggregate total* labor bill? With homothetic preferences and production technologies (and ignoring trade effects, $\varepsilon = 1$), a given amount of spending generates the same proportional change on the labor bill in *all* sectors. In particular, the proportional change of the labor bill in the nontradable sectors—which we estimate with our local labor market approach—is the same as the proportional change of the labor bill in the tradable sectors, which we cannot estimate directly due to demand slippage to other regions. While clearly convenient for aggregation, the homotheticity assumption also has empirical grounding in the unconditional comovement of the nontradable labor bill and the aggregate labor bill at the national level.[33]

We next quantify the effect on aggregate labor. Using Eqs. (20) and (23) and setting the Frisch elasticity φ^{-1} to 0.5 (Chetty et al., 2012) and the nontradable share η to 0.5 (a conservative value) yields $\kappa^A = 2$.[34] Then, Eqs. (22) and (24) imply:

$$\Delta l_0 = \frac{1}{1+\kappa^A}\Delta\left(w_0 + l_0\right) = \frac{1}{1+\kappa^A}\mathcal{M}^A\left(1-\alpha\right)\rho \times S_0^A R_0^A. \tag{25}$$

Substituting in the value of κ^A and the response of the labor bill, we obtain:

$$\frac{1}{1+\kappa^A}\mathcal{M}^A\left(1-\alpha\right)\rho \geq \frac{2.83\%}{3}\frac{\mathcal{M}^A}{\mathcal{M}} \geq 0.94\%.$$

Therefore, a one dollar increase in stock valuations increases aggregate labor (total hours worked) by the equivalent of at least 0.94 cents (i.e. the labor bill for the additional hours worked is at least 0.94 cents) if monetary policy does not respond.

We can combine these estimates with the ratio of aggregate stock wealth to the aggregate yearly labor bill, S_0^A, to obtain the responses to a stock return, R_0^A. Using data from 2015 (weighting counties by their income), we obtain $S^A = 1.50$. Substituting this value into Eqs. (24) and (25), we obtain:

$$\Delta\left(w_0 + l_0\right) \quad = \quad 4.25\%\frac{\mathcal{M}^A}{\mathcal{M}} \times R_0^A \geq 4.25\% \times R_0^A,$$

[33]Specifically, using QCEW national data, a regression of the 8 quarter (our baseline horizon) log change in the labor bill in all other sectors on the 8 quarter change in the nontradable labor bill yields a coefficient of 0.96 (Newey standard error with bandwidth 8 of 0.077) and an R^2 of 0.79. Adding a time trend changes the coefficient to 0.93 (standard error 0.073). Thus, the national data do not reject homotheticity, and can reject large departures from homotheticity.

[34]As we have emphasized, the nontradable share of consumption expenditure η is a difficult parameter to calibrate given available regional data. Dupor et al. (2019) use the Commodity Flow Survey to estimate that two-thirds of shipments remain within a metropolitan area and 61% remain within a county. This estimate excludes the services component of consumption, which likely has a higher nontradable share. On the other hand, it may include some shipments within a local supply chain that eventually produces a tradable good.

$$\Delta l_0 \quad \geq \quad 1.42\% \frac{\mathcal{M}^A}{\mathcal{M}} \times R_0^A \geq 1.42\% \times R_0^A.$$

Therefore, if not countered by monetary policy, a 20% stock return—approximately the yearly standard deviation of the return on the S&P 500—would increase the aggregate labor bill by at least 0.85%, and aggregate hours by at least 0.28%, at a horizon of two years.

8 Conclusion

We estimate the effect of stock market wealth on labor market outcomes by exploiting regional heterogeneity in stock wealth across U.S. counties. An increase in stock wealth in a county increases local employment and the labor bill, especially in nontradable industries but also in total, but does not increase employment in tradable industries. We use a theoretical model to convert the estimated local general equilibrium effect into a partial equilibrium MPC out of stock market wealth of around 2.8 cents per year. We also calculate the aggregate general equilibrium effects of the stock wealth consumption channel on the labor market: a 20% change in stock valuations, unless countered by monetary policy, affects the aggregate labor bill by at least 0.85% and aggregate hours by at least 0.28% two years after the shock.

An important practical question concerns the speed at which stock wealth changes affect the economy. We find evidence of sluggish adjustment, with the effect on labor markets starting after 1 to 2 quarters and stabilizing between quarters 4 and 8. This pattern suggests that large stock price declines that quickly reverse course—such as the stock market crash of 1987 or the Flash crash of 2010—are unlikely to impact labor markets, whereas more persistent price changes—such as the NASDAQ boom in the late 1990s or the stock market boom of recent years—have more sizeable effects.

Our focus on the consumption channel and our empirical design omit factors that could further increase the effect of stock market wealth changes on aggregate labor markets. First, as discussed by Chodorow-Reich (2019), the Keynesian multiplier effects are likely greater at the aggregate level (when monetary policy is passive) than at the local level. Second, other channels, such as the response of investment, also create a positive relationship between stock prices and aggregate demand (see Caballero and Simsek, 2017). Relatedly, while our industry-level analysis mostly focuses on sectors that produce nondurable goods and services, we also find that stock price changes have a large effect on the construction sector. The construction response provides further qualitative evidence that stock wealth affects the economy by changing local demand and inducing an accelerator-type effect on housing investment (see Rognlie et al., 2018; Howard, 2017). We leave a quantitative assessment of these additional factors for future work.

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Stock Market Wealth and the Real Economy: A Local Labor Market Approach

Online Appendix

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A Model Details

In this appendix, we present the full model. In Section A.1, we describe the environment and define the equilibrium. For completeness, we repeat the key equations shown in the main text. In Section A.2, we provide a general characterization of equilibrium. In Section A.3, we provide a closed form solution for a benchmark case in which areas have the same stock wealth. In Section A.4, we log-linearize the equilibrium around the common-wealth benchmark and provide closed form solutions for the log-linearized equilibrium with heterogeneous stock wealth. In Section A.5, we use our results to characterize the cross-sectional effects of shocks to stock valuations. In Section A.6, we establish the robustness of the benchmark calibration of the model that we present in the main text. In Section A.7, we analyze the aggregate effects of shocks to stock valuations (when monetary policy is passive) and compare the results with our earlier results on the cross-sectional effects. Finally, we consider two extensions of the baseline model. In Section A.8, we extend the model to incorporate uncertainty, and we show that our results are robust to obtaining the stock price fluctuations from alternative sources such as changes in households' risk aversion or perceived risk. In Section A.9, we extend the model to consider more general levels for the EIS parameter and discuss how it would affect our analysis.

A.1 Environment and Definition of Equilibrium

Basic Setup and Interpretation. There are two factors of production: capital and labor. There is a continuum of measure one of areas (counties) denoted by subscript a. Areas are identical except for their initial ownership of capital.

There are two periods $t \in \{0, 1\}$. We view period 1 as "the long run" over which wages are flexible and all factors are mobile across the areas. In the long run, outcomes will be determined by productivity. In contrast, period 0 corresponds to "the short run" over which wages are somewhat sticky and labor is not mobile. In this case, outcomes will be determined by aggregate demand. Hence, we interpret a period in the model as corresponding to several years.

Our focus is to understand how fluctuations in stock wealth affect cross-sectional and aggregate outcomes in the short run. To this end, we will generate endogenous changes in the price of capital in period 0 from exogenous changes to the productivity of capital in period 1. We interpret these changes as capturing stock price fluctuations due to a "time-varying risk premium." We validate the risk premium interpretation in Section A.8, where we introduce uncertainty about capital productivity in period 1.

Goods and Production Technologies. In every period t, there is a tradable good that can be consumed everywhere. For each area a, there is also a corresponding nontradable good that can only be produced and consumed in area a. Labor and capital are perfectly mobile across the production technologies described below (but labor is not mobile across areas in period 0 as we will describe later). We assume production firms are competitive and not subject to nominal rigidities (we will assume nominal rigidities in the labor market).

In every area, there is a standard neoclassical production technology, $F(K_t, L_t)$, that can be used to produce either the nontradable good or the local input for the composite tradable good. For simplicity, we assume the standard production technology is Cobb-Douglas,[1]

$$F(K_t, L_t) = (K_t/\alpha)^{\alpha} (L_t/(1-\alpha))^{1-\alpha}. \tag{A.1}$$

There is also a capital-only technology that can be used to produce the tradable good. This technology is linear,

$$G_t(K_t) = D_t^{1-\alpha} K_t. \tag{A.2}$$

Here, $D_t^{1-\alpha}$, captures the capital productivity in period t. The normalizing power $1-\alpha$ ensures that we obtain relatively simple expressions. As we will verify below, the rental rate (and thus, the price) of capital will depend on the productivity in the capital-only sector, D_t.

More specifically, the nontradable good in area a can be produced according to the standard technology,

$$Y_{a,t}^N = F\left(K_{a,t}^N, L_{a,t}^N\right) = \left(K_{a,t}^N/\alpha\right)^{\alpha} \left(L_{a,t}^N/(1-\alpha)\right)^{1-\alpha}. \tag{A.3}$$

Here, $L_{a,t}^N$ (resp. $K_{a,t}^N$) denotes the area a labor (resp. aggregate capital) employed in the nontradable sector in area a.

The tradable good can be produced in two ways. First, it can be produced as a composite of tradable inputs across areas, where each input is produced according to the standard technology:

$$\begin{aligned} Y_t^T &= \left(\int_a \left(Y_{a,t}^T\right)^{\frac{\varepsilon-1}{\varepsilon}} da\right)^{\frac{\varepsilon}{\varepsilon-1}} \\ \text{where } Y_{a,t}^T &= F\left(K_{a,t}^T, L_{a,t}^T\right) = \left(K_{a,t}^T/\alpha\right)^{\alpha} \left(L_{a,t}^T/(1-\alpha)\right)^{1-\alpha}. \end{aligned} \tag{A.4}$$

Here, $L_{a,t}^T$ (resp. $K_{a,t}^T$) denotes the area a labor (resp. aggregate capital) employed in the tradable sector in area a. The parameter, $\varepsilon > 0$, captures the elasticity of substitution across tradable inputs.

[1] This formulation sets the expected labor productivity growth to zero. At the expense of additional notation, we could introduce a productivity parameter, A_t, and make it grow between periods 0 and 1.

When $\varepsilon > 1$ (resp. $\varepsilon < 1$), tradable inputs are gross substitutes (resp. gross complements).

Second, the tradable good can also be produced by the capital-only technology,

$$\tilde{Y}_t^T = G_t\left(\tilde{K}_t^T\right) = D_t^{1-\alpha}\tilde{K}_t. \tag{A.5}$$

Here, $\tilde{K}_t^T$ denotes the aggregate capital employed in the capital-only technology, and $\tilde{Y}_t^T$ denotes the tradables produced via this technology (we use the tilde notation to distinguish them from K_t^T and Y_t^T).

Combining Eqs. $(A.4)$ and $(A.5)$, we can also write the overall production of the tradable good as,

$$Y_t^T = Y_t^T + \tilde{Y}_t^T = \left(\int_a F\left(K_{a,t}^T, L_{a,t}^T\right)^{\frac{\varepsilon-1}{\varepsilon}} da\right)^{\frac{\varepsilon}{\varepsilon-1}} + G_t\left(\tilde{K}_t^T\right).$$

Capital Supply. In each period t, capital supply is exogenous,

$$K_t = \overline{K} \equiv 1 \text{ for each } t \in \{0, 1\}. \tag{A.6}$$

To simplify the notation, we normalize the exogenous capital supply to one. Capital is perfectly mobile across areas in both periods (so its location is not important).

Financial Assets. There are two financial assets. First, there is a claim to capital (which we view as corresponding to the stock market). We let Q_0 denote the nominal cum-dividend price of capital in period 0. Recall that the supply of capital is normalized to one and its nominal rental rate is denoted by R_t. Thus, $Q_0 - R_0$ denotes the nominal ex-dividend price at the end of period 0.

Second, there is also a risk-free asset in zero net supply. We let R^f denote the nominal gross risk-free interest rate.

Heterogeneous Ownership of Capital. Households in different areas start with zero units of the risk-free asset but they can differ in their endowments of capital. Specifically, we let $1 + x_{a,t}$ denote the share of aggregate capital held by investors in area a in period t. The initial shares, $\{1 + x_{a,0}\}_a$, are exogenous and can be heterogeneous. The common-wealth benchmark corresponds to the special case with $x_{a,0} = 0$ for each a.

Nominal Prices. We let $W_{a,t}$ and $P_{a,t}^N$ denote, respectively, the nominal wage per unit of labor and the nominal price of the nontradable good in period t and area a. Likewise, we let R_t and P_t^T denote, respectively, the (nominal) rental rate of capital and the (nominal) price of the tradable good in period t.

Note that our assumption that labor is mobile across areas in period 1 implies that the nominal wage in period 1 is the same across areas. We assume monetary policy stabilizes the nominal long-run wage at a constant level, that is:

$$W_{a,1} = \overline{W} \text{ for each } a. \tag{A.7}$$

Households' Optimization Decisions. The representative household in each area separates its consumption and labor choices as follows. At the beginning of period 0, the household splits into a consumer and a continuum of workers. The consumer makers consumption-saving decisions and the workers choose labor supply. At the end of the period the household recombines and makes a portfolio decision to allocate savings between capital (stock wealth) and the risk-free asset.[2]

We choose to model consumption and labor decisions separately for two reasons. First, assuming workers choose labor according to Greenwood et al. (1988) (GHH) preferences allows us to ignore the wealth effects of labor supply. Second, we can endow consumers with standard time-separable preferences. In addition to simplifying the subsequent expressions, this setup accords with the fact that workers hold relatively little stock market wealth. At the same time, we sidestep some consequences of GHH preferences, such as leading to unplausibly large fiscal and monetary multipliers (Auclert and Rognlie, 2017)

Consumption-Saving and Portfolio Choice Problem. The household in area a divides its consumption $C_{a,t}$ between the tradable good, $C^T_{a,t}$, and the nontradable good, $C^N_{a,t}$, according to the intra-period preferences:

$$C_{a,t} = \left(C^N_{a,t}/\eta\right)^{\eta} \left(C^T_{a,t}/\left(1-\eta\right)\right)^{1-\eta}. \tag{A.8}$$

With this normalization, the ideal price index is given by,

$$P_{a,t} \equiv \left(P^N_{a,t}\right)^{\eta} \left(P^T_t\right)^{1-\eta}. \tag{A.9}$$

Households can be thought of as choosing the consumption aggregator $C_{a,t}$ at these prices. They then distribute their spending optimally across the two sectors. The optimal expenditure on each sector satisfies,

$$P^N_{a,t} C^N_{a,t} = \eta P_{a,t} C_{a,t} \text{ and } P^T_{a,t} C^T_{a,t} = \left(1-\eta\right) P_{a,t} C_{a,t}. \tag{A.10}$$

The consumer in the household has inter-period preferences described by time-separable log utility (cf. Eq. (1)). The consumer chooses how much to consume and save and how to allocate savings across capital and the risk-free asset. The consumer's problem can then be written as,

$$\begin{aligned} &\max_{C_{a,0}, 1+x_{a,1}} \log C_{a,0} + \delta \log C_{a,1} \\ &P_{a,0} C_{a,0} + S_{a,0} = W_{a,0} L_{a,0} + \left(1 + x_{a,0}\right) Q_0, \\ &S_{a,0} = S^f_{a,0} + \left(1 + x_{a,1}\right) \left(Q_0 - R_0\right) \end{aligned} \tag{A.11}$$

[2]Without loss of generality, we allow the consumer to make the portfolio decision as well

$$P_{a,1}C_{a,1} = \overline{W}\overline{L}_1 + (1 + x_{a,1}) R_1 + S^f_{a,0} R^f.$$

Here, $1 + x_{a,1}$ denotes the units of capital that the household purchases. This purchase costs $(1 + x_{a,1}) (Q_0 - R_0)$ units of the consumption good in period 0. Households invest the rest of their savings, $S^f_{a,0} = S_{a,0} - (1 + x_{a,1}) (Q_0 - R_0)$, in the risk-free asset.

Labor Supply Problem. In period 1, the labor supply is exogenous (and constant across areas), that is:

$$L_{a,1} = \overline{L}_1 \text{ for each } a. \tag{A.12}$$

In period 0, the labor supply is endogenous. For the purpose of endogenizing the labor supply, we work with a GHH functional form for the intraperiod preferences between consumption and labor that eliminates the wealth effects on the labor supply. These effects seem counterfactual for business cycle analysis in general (Galí (2011)). In our context, they are likely to be insignificant also because stock wealth is a relatively small fraction of total household wealth (including human capital wealth).

Specifically, in each area the representative household consists of a continuum of workers denoted by $\nu \in [0, 1]$. The workers provide specialized labor services. They set their individual wages and labor supply to maximize the intra-period utility function:

$$\log \left(C_{a,0} - \chi \int_0^1 \frac{(L_{a,0} (\nu))^{1+\varphi}}{1 + \varphi} d\nu \right). \tag{A.13}$$

Here, $C_{a,0}$ denotes the composite of nontradable and tradable goods as in the main model and $L_{a,0} (\nu)$ denotes the labor supply by worker ν who specializes in providing a particular type of labor service. The parameter, φ, captures the inverse Frisch elasticity of the labor supply; and the parameter, χ, captures the disutility form labor. The intraperiod budget constraint is given by:

$$P_{a,0}C_{a,0} + S_{a,0} = \int_0^1 W_{a,0} (\nu) L_{a,0} (\nu) d\nu + (1 + x_{a,0}) Q_0. \tag{A.14}$$

Here, $P_{a,0}$ denotes the ideal price index over nontradable and tradable goods.

In each area a, there is also an intermediate firm that produces the labor services in the area by combining specific labor inputs from each worker type according to the aggregator:

$$L_{a,0} = \left(\int_0^1 L_{a,0} (\nu)^{\frac{\varepsilon_w - 1}{\varepsilon_w}} d\nu \right)^{\frac{\varepsilon_w}{\varepsilon_w - 1}}.$$

This leads to the labor demand equation:

$$L_{a,0} (\nu) = \left(\frac{W_{a,0} (\nu)}{W_{a,0}} \right)^{-\varepsilon_w} L_{a,0} \tag{A.15}$$

$$\text{where } W_{a,0} = \left(\int_0^1 W_{a,0}(\nu)^{1-\varepsilon_w} d\nu\right)^{1/(1-\varepsilon_w)}. \tag{A.16}$$

Here, $L_{a,0}$ denotes the aggregate equilibrium labor provided by the intermediate firm, which is the same as the labor supply in the main text.

In period 0, a fraction of the workers in an area, λ_w, reset their wages to maximize the intra-period utility function in $(A.13)$ subject to the labor demand equation in $(A.15)$ and the budget constraints in $(A.14)$. The remaining fraction, $1 - \lambda_w$, have preset wages given by $\overline{W}$ (which is the same as the long-run wage level for simplicity).

The wage level in an area is determined according to the ideal price index $(A.16)$. This index also ensures:

$$\int_0^1 W_{a,0}(\nu) L_{a,0}(\nu) d\nu = W_{a,0} L_{a,0}.$$

Substituting this into Eq. $(A.14)$, we obtain the budget constraint in problem $(A.11)$ stated earlier.

Optimal Wage Setting and the Wage Phillips Curve. First consider the flexible workers that reset their wages in period 0. These workers optimally choose $\left(W_{a,0}^{flex}, L_{a,0}^{flex}\right)$ that satisfy:

$$W_{a,0}^{flex} \equiv P_{a,0} \frac{\varepsilon_w}{\varepsilon_w - 1} MRS_{a,0} \tag{A.17}$$

$$\text{where } MRS_{a,0} = \chi \left(L_{a,0}^{flex}\right)^{\varphi} \text{ and } L_{a,0}^{flex} = \left(\frac{W_{a,0}^{flex}}{W_{a,0}}\right)^{-\varepsilon_w} L_{a,0}$$

In particular, workers set a real (inflation-adjusted) wage that is a constant markup over their marginal rate of substitution between labor and consumption (MRS). The functional form in $(A.13)$ ensures that the MRS depends on the level of labor supply but not on the level of consumption.

Note that $W_{a,0}^{flex}$ appears on both side of Eq. $(A.17)$. Solving for the fixed point, we further obtain:

$$\left(W_{a,0}^{flex}\right)^{1+\varphi\varepsilon_w} = \frac{\varepsilon_w}{\varepsilon_w - 1} \chi P_{a,0} W_{a,0}^{\varepsilon_w \varphi} L_{a,0}^{\varphi}. \tag{A.18}$$

Next consider the sticky workers. These workers have preset wages, $\overline{W}$, and they provide the labor services demanded at these wages.

Next we use $(A.16)$ to obtain an expression for the aggregate wage level:

$$\begin{aligned} W_{a,0} &= \left(\lambda_w \left(W_{a,0}^{flex}\right)^{1-\varepsilon_w} + (1-\lambda_w)\overline{W}^{1-\varepsilon_w}\right)^{1/(1-\varepsilon_w)} \\ &= \left(\lambda_w \left(\frac{\varepsilon_w}{\varepsilon_w - 1}\chi W_{a,0}^{\varepsilon_w\varphi} P_{a,0} L_{a,0}^{\varphi}\right)^{(1-\varepsilon_w)/(1+\varphi\varepsilon_w)} + (1-\lambda_w)\overline{W}^{1-\varepsilon_w}\right)^{1/(1-\varepsilon_w)}. \end{aligned} \tag{A.19}$$

Here, the first line substitutes the wages of flexible and sticky workers. The second line substitutes the optimal wage for flexible workers from Eq. $(A.18)$. As we show in Section A.4 below, log-linearizing Eq. $(A.19)$ leads to Eq. (4) in the main text. Eq. $(A.19)$ illustrates that greater employment in an area, $L_{a,0}$, creates wage pressure. The amount of pressure depends positively on the fraction of flexible workers, λ_w, and negatively on the labor supply elasticity, $1/\varphi$, as well as on the elasticity of substitution across labor types, ε_w. An increase in the local price index, $P_{a,0}$, also creates wage pressure.

It is also instructive to consider the special case in which wages are fully flexible, $\lambda_w = 1$. In this case, all workers set the same wage, which implies $W_{a,0}^{flex} = W_{a,0}$. Using this observation Eq. $(A.19)$ becomes:

$$\frac{W_{a,0}}{P_{a,0}} = \frac{\varepsilon_w}{\varepsilon_w - 1} \chi L_{a,0}^{\varphi}. \tag{A.20}$$

Hence, the frictionless labor supply in each area a is described by a neoclassical intratemporal optimality condition. In particular, real wage is a constant markup over the MRS between labor and consumption.

Market Clearing Conditions. The goods market clearing conditions for the nontradable good and the tradable good can be written as,

$$\begin{aligned} Y_{a,t}^N &= C_{a,t}^N & \text{(A.21)} \\ Y_t^T &= Y_t^T + \tilde{Y}_t^T = \int_a C_{a,1}^T da, & \text{(A.22)} \end{aligned}$$

where $Y_{a,t}^N, Y_t^T, \tilde{Y}_t^T$ are given by Eqs. $(A.3 - A.5)$.

Labor and capital market clearing conditions for period 0 can be written as,

$$\begin{aligned} L_{a,0} &= L_{a,0}^N + L_{a,0}^T \text{ for each } a & \text{(A.23)} \\ \overline{K} &= 1 = \int_a \left(K_{a,0}^N + K_{a,0}^T\right) da + \tilde{K}_0^T. & \text{(A.24)} \end{aligned}$$

The analogous conditions for period 1 can be written as,

$$\begin{aligned} \overline{L}_1 &= \int_a \left(L_{a,1}^N + L_{a,1}^T\right) da & \text{(A.25)} \\ \overline{K} &= 1 = \int_a \left(K_{a,1}^N + K_{a,1}^T\right) da + \tilde{K}_1^T. & \text{(A.26)} \end{aligned}$$

Note that there is a single market clearing condition for capital because capital is mobile in either period. Likewise, there is a single market clearing condition for labor in period 1. In contrast, there is a separate market clearing condition in each area for labor in period 0.

Finally, the asset market clearing condition can be written as,

$$\int_a x_{a,1} da = 0. \tag{A.27}$$

Monetary Policy and Equilibrium. To close the model, it remains to specify how the monetary policy sets the nominal interest rate, R^f. For most of the analysis, we assume that the monetary policy sets R^f to ensure aggregate employment is "on average" equal to frictionless employment.

Specifically, we define $\overline{L}_0$ as the frictionless labor supply that would obtain when all areas have common wealth. It is the solution to the frictionless labor supply equation [cf. $(A.20)$]:

$$\frac{W_0}{P_0} = \frac{\varepsilon_w}{\varepsilon_w - 1}\chi \overline{L}_0^{\varphi}, \tag{A.28}$$

where $W_0 = W_{0,a}$ and $P_0 = P_{0,a}$ denote the common wage and price level across areas. Below, we characterize P_0 in terms of W_0 and the remaining parameters and provide a closed form solution for $\overline{L}_0$. We assume monetary policy sets R^f to ensure:

$$\int_a L_{a,0} da = \overline{L}_0. \tag{A.29}$$

We can then define the equilibrium as follows.

Definition 1. *Given a distribution of ownership of capital, $\{x_{a,0}\}_a$ (that sum to zero across areas), an equilibrium is a collection of cross-sectional and aggregate allocations together with (nominal) factor prices, $\left(\{W_{a,t}\}_a, R_t\right)$, goods prices, $\left(\{P_{a,t}^N\}_a, P_t^T\right)$, the asset price, Q_0, and the interest rate, R^f, such that:*

(i) Competitive firms maximize according to the production technologies described in $(A.1 - A.5)$.

(ii) Households choose their consumption and portfolios optimally [cf. problem $(A.11)$].

(ii) Capital supply is exogenous in both periods and given by $(A.6)$. Labor supply and nominal wages in period 1 are exogenous and given by Eqs. $(A.12)$ and $(A.7)$. Labor supply and nominal wages in period 0 are endogenous and satisfy Eq. $(A.19)$.

(iv) Monetary policy sets the interest rate R^f to ensure Eq. $(A.29)$ with $\overline{L}_0$ that solves Eq. $(A.28)$.

(v) Goods, factors, and asset markets clear [cf. Eqs. $(A.21 - A.27)$].

A.2 General Characterization of Equilibrium

We next provide a general characterization of equilibrium. We start by establishing the properties on the supply side that apply in both periods. We then use these properties to characterize the equilibrium in period 1. We then establish properties on the demand side and characterize the equilibrium in period 0. Throughout, we focus on an equilibrium in which the capital only technology is used in equilibrium, $\tilde{K}_t \geq 0$. Later in the appendix (when we focus on special cases), we will ensure this by making appropriate parametric assumptions on D_t.

Supply Side. The production technologies described in $(A.1 - A.5)$ imply that the nominal price of goods are related to nominal factor prices according to,

$$\begin{aligned} P_{a,t}^N &= U_{a,t} \equiv W_{a,t}^{1-\alpha} R_t^{\alpha}, \\ P_t^T &= \left(\int_a U_{a,t}^{1-\varepsilon} da \right)^{1/(1-\varepsilon)} \\ P_t^T &= R_t / D_t^{1-\alpha}. \end{aligned} \tag{A.30}$$

Here, the second equality in the first line defines the variable, $U_{a,t}$, which we refer to as the unit cost of production (for either the nontradable good or the local tradable input) in area a.

Note that we can combine the last two equations in $(A.30)$ to obtain an expression for the rental rate of capital in terms of wages (and the parameter, D_t),

$$R_t^{1-\alpha} = D_t^{1-\alpha} \left(\int_a \left(W_{a,t}^{1-\alpha} \right)^{1-\varepsilon} da \right)^{1/(1-\varepsilon)}. \tag{A.31}$$

Hence, the rental rate of capital is determined by the productivity of the linear technology together with wages in each area (that determine the price of the tradable good). This also implies that, given the wages in each area, we can uniquely calculate all other prices. Recall also that Eq. $(A.9)$ characterizes the total price of consumption in an area, $P_{a,t}$, in terms of the price of nontradable and tradable goods, $P_{a,t}^N, P_t^T$. The following lemma formalizes these results, and characterizes the prices when wages are equated across areas.

Lemma 1. *Given a collection of strictly positive nominal wages, $\{W_{a,t}\}_a$ and capital productivity, D_t, Eq. $(A.31)$ uniquely determines the rental rate of capital and Eqs. $(A.30)$ and Eq. $(A.9)$ uniquely determine unit costs and goods prices, $U_{a,t}, P_{a,t}^N, P_t^T, P_{a,t}$. If $W_{a,t} \equiv W_t$ for each a, then $R_t = D_t W_t$, $P_{a,t}^N = U_{a,t} = P_t^T = P_{a,t} = D_t^{\alpha} W_t$.*

We next characterize the demand for labor in the nontradable and tradable sectors. Note that the Cobb-Douglas production function in $(A.3)$ implies,

$$\begin{aligned} W_{a,t} L_{a,t}^N &= (1-\alpha) U_{a,t} Y_{a,t}^N, \\ \text{where } U_{a,t} Y_{a,t}^N &= P_{a,t}^N C_{a,t}^N. \end{aligned} \tag{A.32}$$

Here, the second line substitutes the market clearing condition $(A.21)$ and observes that $U_{a,t} = P_{a,t}^N$. Hence, the demand for nontradable labor in an area is determined by the demand for nontradable goods in the area.

Likewise, the Cobb-Douglas production function in $(A.4)$ implies,

$$W_{a,t} L_{a,t}^T = (1-\alpha) U_{a,t} Y_{a,t}^T.$$

That is, the demand for tradable labor in an area is determined by the demand for tradable inputs from the area. To characterize this further, note that the CES production function in $(A.5)$ implies,

$$U_{a,t}Y_{a,t}^T = \left(\frac{U_{a,t}}{P_t^T}\right)^{1-\varepsilon} P_t^T Y_t^T.$$

So the demand for tradable inputs in an area depends on the demand for the tradable good in the aggregate (that uses the standard technology) as well as the local unit cost. The elasticity parameter, ε, captures the sensitivity of demand to the local unit cost.

Combining these expressions, we further obtain,

$$\begin{aligned} W_{a,t}L_{a,t}^T &= (1-\alpha)\left(\frac{U_{a,t}}{P_t^T}\right)^{1-\varepsilon} P_t^T Y_t^T, \qquad (A.33) \\ \text{where } P_t^T Y_t^T &= \int_a P_t^T C_{a,t}^T da - P_t^T \tilde{Y}_t^T \text{ and } P_t^T \tilde{Y}_t^T = R_t \tilde{K}_t^T. \end{aligned}$$

Here, the second line substitutes the market clearing condition $(A.22)$ and Eq. $(A.5)$. In particular, the demand for tradables in the aggregate that uses the standard technology is determined by the total demand for tradables net of the production via the capital-only technology. The following lemma summarizes this discussion. It also characterizes Eq. $(A.33)$ further by solving for the amount of production in the tradable sector via the capital-only technology, $P_t^T \tilde{Y}_t^T = R_t \tilde{K}_t^T$.

Lemma 2. *The demand for nontradable labor is given by Eq.* $(A.32)$. *The demand for tradable labor is given by Eq.* $(A.33)$. *In equilibrium, the amount of capital employed in the capital-only technology satisfies,*

$$R_t \tilde{K}_t^T = R_t - \frac{\alpha \int_a W_{a,t}L_{a,t}da}{1-\alpha}. \qquad (A.34)$$

Therefore, Eq. $(A.33)$ *can be further solved as,*

$$W_{a,t}L_{a,t}^T = (1-\alpha)\left(\frac{U_{a,t}}{P_t^T}\right)^{1-\varepsilon}\left[\int_a P_t^T C_{a,t}^T da - R_t + \frac{\alpha}{1-\alpha}\int_a W_{a,t}L_{a,t}da\right]. \qquad (A.35)$$

The intuition for Eq. $(A.35)$ is as follows. The amount of production in the capital-only technology depends on the total payoff to capital ($R_t\overline{K} = R_t$) with some slippage due to the fact that some capital is also employed in the standard technologies. The last term in the brackets characterizes the amount of slippage in equilibrium: that is, the payoff to capital in the standard technologies. This payoff is proportional to the total payoff to labor (all of which is employed in standard technologies) because the standard technologies are Cobb-Douglas.

Proof. To establish Eq. $(A.35)$, note that the analogue of Eqs. $(A.32)$ and $(A.33)$ also apply for capital. In particular, after aggregating across areas, we have,

$$R_t \int_a K_{a,t}^N da = \alpha \int_a P_{a,t}^N C_{a,t}^N da$$

$$R_t \int_a K_{a,t}^T da \quad = \quad \alpha \left(\int_a P_t^T C_{a,t}^T da - R_t \tilde{K}_t^T \right).$$

Here, the second line uses $P_t^T = \left(\int_a U_{a,t}^{1-\varepsilon} da \right)^{1/(1-\varepsilon)}$. Adding these equations, and using the market clearing condition for capital in $(A.24)$ and $(A.26)$, we obtain,

$$R_t \left(1 - \tilde{K}_t^T\right) = \alpha \left(\int_a P_{a,t}^N C_{a,t}^N da + \int_a P_t^T C_{a,t}^T da - R_t \tilde{K}_t^T \right). \tag{A.36}$$

Next note that, in equilibrium, aggregate consumption expenditure is equal to aggregate income,

$$\int_a P_{a,t}^N C_{a,t}^N da + \int_a P_t^T C_{a,t}^T da = \int_a W_{a,t} L_{a,t} da + R_t.$$

Substituting this into Eq. $(A.36)$, we solve for the production of tradables via capital-only technology as,

$$R_t \tilde{K}_t^T = R_t - \frac{\alpha \int_a W_{a,t} L_{a,t} da}{1 - \alpha}.$$

This establishes Eq. $(A.34)$. Substituting this expression into Eq. $(A.33)$, we obtain Eq. $(A.35)$, completing the proof. □

Equilibrium in Period 1 (Long Run). Our analysis so far enables us to characterize the equilibrium in period 1. Since labor is mobile across areas, the wages are equated across areas, $W_{a,1} \equiv \overline{W}$ for each a. Then, using Lemma 1, we obtain,

$$R_1 = D_1 \overline{W}. \tag{A.37}$$

Thus, the nominal rental rate of capital is determined by the productivity of capital, D_1, together with the the long-run nominal wage level, $\overline{W}$.

We can also explicitly solve for the aggregate consumption in nontradables and tradables, as well as the allocation of factors to these sectors. We skip these steps since they are not necessary for our analysis.

Average Labor Supply in Period 0 (Short Run). We can also utilize the analysis so far to solve Eq. $(A.28)$. Recall that this equation corresponds to the frictionless labor supply when all areas have common stock wealth. It describes the average labor supply $\overline{L}_0$ that monetary policy targets with an arbitrary distribution of stock wealth [cf. $(A.38)$].

When areas have common wealth, wages are equated across areas, $W_{a,0} = W_0$ for each a. Using Lemma 1, we also obtain $P_0 = D_0^\alpha W_0$. Substituting these expressions into $(A.28)$, we obtain:

$$\frac{W_0}{P_0} = \frac{1}{D_0^\alpha} = \frac{\varepsilon_w}{\varepsilon_w - 1} \chi \overline{L}_0^\varphi. \tag{A.38}$$

Note that, given the other parameters, there is a unique solution to Eq. $(A.38)$ that describes the frictionless labor supply $\overline{L}_0$. We next turn to the demand side and characterize the rest of the equilibrium in period 0.

Asset Prices in Period 0 (Short Run). Next consider households' portfolio decision in period 0. Since there is no risk in capital (for simplicity), problem $(A.11)$ implies households take a non-zero position on capital if and only if its price satisfies,

$$\begin{aligned} Q_0 &= R_0 + \frac{R_1}{R^f} \\ &= R_0 + \frac{D_1 \overline{W}}{R^f}. \end{aligned} \tag{A.39}$$

Here, the second line substitutes for the future rental rate of capital from Eq. $(A.37)$. Hence, a standard asset pricing condition applies to capital. In particular, households' stock wealth depends on (among other things) the productivity of capital and the interest rate, R^f.

Demand Side in Period 0 (Short Run). We next consider the households' consumption-savings decision in period 0. We define the households' human capital wealth in an area as,

$$H_{a,0} = W_{a,0} L_{a,0} + \frac{\overline{WL_1}}{R^f}. \tag{A.40}$$

We can then rewrite the households' budget constraints in $(A.11)$ as a lifetime budget constraint,

$$P_{a,0} C_{a,0} + P_{a,1} C_{a,1} = H_{a,0} + (1 + x_{a,0}) Q_0.$$

Combining this with log utility, we obtain the optimality condition,

$$P_{a,0} C_{a,0} = \frac{1}{1+\delta} \left(H_{a,0} + (1 + x_{a,0}) Q_0 \right). \tag{A.41}$$

That is, households spend a constant fraction of their lifetime wealth, where the latter is a combination of their human capital and stock wealth. Combining this with Eq. $(A.10)$, we further obtain,

$$P_{a,0}^N C_{a,0}^N = \frac{\eta}{1+\delta} \left(H_{a,0} + (1 + x_{a,0}) Q_0 \right), \tag{A.42}$$

$$P_0^T C_{a,0}^T = \frac{1-\eta}{1+\delta} \left(H_{a,0} + (1 + x_{a,0}) Q_0 \right). \tag{A.43}$$

We next combine Eq. $(A.42)$ with Eq. $(A.32)$ from Lemma 2 to obtain,

$$W_{a,0} L_{a,0}^N = \frac{(1-\alpha)\eta}{1+\delta} \left(H_{a,0} + (1 + x_{a,0}) Q_0 \right). \tag{A.44}$$

Thus, nontradable labor demand is determined by the local nontradable demand, which is equal to local wealth multiplied by the share of wealth spent $(1/(1+\delta))$ multiplied by the share of nontradables (η) multiplied by the share of labor $(1-\alpha)$.

Likewise, we combine Eq. $(A.43)$ with Eq. $(A.35)$ from Lemma 2 to obtain,

$$W_{a,0}L_{a,0}^{T}=\left(\frac{U_{a,0}}{P_0^T}\right)^{1-\varepsilon}\left(\frac{(1-\alpha)(1-\eta)}{1+\delta}(H_0+Q_0)-(1-\alpha)R_0+\alpha\int_a W_{a,0}L_{a,0}da\right). \tag{A.45}$$

Here, we define the aggregate human capital wealth as, $H_0=\int_a H_{a,0}da$. Hence, tradable labor demand is determined by aggregate demand for the tradable good, which depends on the aggregate wealth and similar coefficients as above.

After summing Eqs. $(A.44)$ and $(A.45)$ and rearranging terms, we obtain an expression for the total labor demand in an area as follows,

$$\begin{aligned} W_{a,0}L_{a,0} &= \frac{(1-\alpha)\eta}{1+\delta}(H_{a,0}+(1+x_{a,0})Q_0) \qquad (A.46)\\ &+\left(\frac{U_{a,0}}{P_0^T}\right)^{1-\varepsilon}\left(\frac{(1-\alpha)(1-\eta)}{1+\delta}(H_0+Q_0)-(1-\alpha)R_0+\alpha\int_a W_{a,0}L_{a,0}da\right). \end{aligned}$$

After substituting $H_{a,0}$ from Eq. $(A.40)$, we can also write the labor demand equation as follows,

$$\begin{aligned} W_{a,0}L_{a,0} &= \frac{(1-\alpha)\eta}{1+\delta}\left(W_{a,0}L_{a,0}+\frac{\overline{WL}_1}{R^f}+(1+x_{a,0})Q_0\right) \qquad (A.47)\\ &+\left(\frac{U_{a,0}}{P_0^T}\right)^{1-\varepsilon}\left(\frac{(1-\alpha)(1-\eta)}{1+\delta}\left(\int_a W_{a,0}L_{a,0}da+\frac{\overline{WL}_1}{R^f}+Q_0\right)-(1-\alpha)R_0+\alpha\int_a W_{a,0}L_{a,0}da\right). \end{aligned}$$

The first line illustrates the local labor demand due to local spending on the nontradable good. The second line illustrates the local labor demand due to aggregate spending on the tradable good.

Next recall from Lemma 1 that the prices, $U_{a,0}, P_0^T, R_0$ are implicit functions of wages, $\{W_{a,0}\}_a$. Therefore, Eq. $(A.47)$ is a collection of $|I|$ equations in $2|I|+1$ unknowns, $\{L_{a,0}, W_{a,0}\}_{a\in I}$ and R^f. Recall also that we have Eq. $(A.19)$ that relates wages to the labor and the price level in each area. This provides $|I|$ additional equations in $\{L_{a,0}, W_{a,0}\}_{a\in I}$. The monetary policy rule in $(A.38)$ provides the remaining equation, where $\overline{L}_0$ is given by Eq. $(A.38)$. The equilibrium is characterized as the solution to these $2|I|+1$ equations.

A.3 Benchmark Equilibrium with Common Stock Wealth

We next characterize the equilibrium further in special cases of interest. In this section, we focus on a benchmark case in which areas have common wealth, $x_{a,0}=0$ for each a, and provide a closed form solution. In the next section, we log-linearize the equilibrium around this benchmark and provide a closed-form solution for the log-linearized equilibrium. Throughout, we assume the productivity in the capital-only technology satisfies:

Assumption D. $D_0 = \frac{\alpha}{1-\alpha}\overline{L}_0$ and $D_1 \geq \frac{\alpha}{1-\alpha}\overline{L}_1$.

To understand the role of this assumption, note that the common-wealth benchmark features identical wages across areas as well as identical and frictionless employment (in either period), $W_{a,t} = W_t$ and $L_{a,t} = \overline{L}_t$. Using this observation, together with Lemmas 1 and 2, we obtain $D_t\tilde{K}_t^T = D_t - \frac{\alpha}{1-\alpha}\overline{L}_t$. Therefore, the inequality $D_t \geq \frac{\alpha}{1-\alpha}\overline{L}_t$ ensures that firms use the capital-only technology in equilibrium, $\tilde{K}_t^T \geq 0$. In period 0, we assume that the inequality holds as equality, which implies that firms are indifferent to use this technology and, moreover, $\tilde{K}_0^T = 0$. Thus, Assumption D ensures that the production in period 0 is homothetic across sectors despite the presence of the capital-only technology in the tradable sector—this homotheticity will be important for some of our results. Assumption D also simplifies the expressions, e.g., it implies that the share of labor is given by its share in the Cobb-Douglas technology, $1-\alpha$.

Recall also that $\overline{L}_0$ is endogenous and corresponds to the solution to Eq. $(A.38)$. Given the other parameters, there is a unique level of $D_0, \overline{L}_0$ that satisfy Assumption D along with this equation.

To characterize the equilibrium in period 0 further, note that the areas are symmetric. Therefore, we drop the area subscript and denote the allocations with, W_0, P_0, L_0, R_0, H_0.

Substituting common wages, prices, and labor into Eq. $(A.19)$ and using Eq. $(A.28)$, we further obtain $W_0 = W_0^{flex} = \overline{W}$. Intuitively, since monetary policy targets the frictionless labor supply, the flexible-wage members of the household set the same wage level as the sticky-wage members. Therefore, the equilibrium wage level is the same as the sticky wage level, $\overline{W}$ (which we take as equal to the long-run wage level). Using Lemma 1, we also obtain, $R_0 = D_0\overline{W}$ and $\overline{P} = D_0^{\alpha}\overline{W}$.

Substituting these observations into the labor demand Eq. $(A.46)$, we obtain,

$$\overline{W}L_0 = \frac{1-\alpha}{1+\delta}\left(H_0 + Q_0\right) - \left(1-\alpha\right)D_0\overline{W} + \alpha\overline{W}L_0.$$

After rearranging terms, we obtain,

$$\overline{W}L_0 = \frac{1}{1+\delta}\left(H_0 + Q_0\right) - D_0\overline{W}.$$

Rearranging further, we obtain,

$$\left(H_0 + Q_0\right)/\overline{W} = \left(1+\delta\right)\left(\overline{L}_0 + D_0\right). \tag{A.48}$$

This expression says that the aggregate wealth (in real terms) must be a constant multiple of the supply-determined output level.

Next note that, after substituting the wages and the rental rate into Eqs. $(A.40)$ and $(A.39)$, human capital and stock wealth are given by, respectively,

$$H_0/\overline{W} \quad = \quad \overline{L}_0 + \frac{\overline{L}_1}{R^{f,*}}, \tag{A.49}$$

$$Q_0/\overline{W} \quad = \quad D_0 + \frac{D_1}{R^{f,*}}. \tag{A.50}$$

Combining the last three expressions, we can solve for "rstar" as,

$$R^{f,*} = \frac{1}{\delta}\frac{\overline{L}_1 + D_1}{\overline{L}_0 + D_0}. \tag{A.51}$$

Intuitively, monetary policy adjusts the interest rate ("rstar") so that aggregate wealth is at an appropriate level to ensure the implied amount of spending clears the goods market at the supply-determined output level. As expected, greater impatience (low δ) or greater expected growth of capital income (high D_1 relative to D_0) or expected growth of labor income (high $\overline{L}_1$ relative to $\overline{L}_0$) translates into a greater interest rate in equilibrium. We can also solve for the equilibrium levels of human capital and stock wealth as,

$$H_0/\overline{W} \quad = \quad \overline{L}_0 + \delta\left(\overline{L}_0 + D_0\right)\frac{\overline{L}_1}{\overline{L}_1 + D_1} \tag{A.52}$$

$$Q_0/\overline{W} \quad = \quad D_0 + \delta\left(\overline{L}_0 + D_0\right)\frac{D_1}{\overline{L}_1 + D_1} \tag{A.53}$$

These expressions are intuitive. For instance, an increase in D_1 increases stock prices as well as the risk-free rate, and it leaves total wealth unchanged. Intuitively, an increase in D_1 exerts upward pressure on aggregate wealth and increases aggregate demand. The interest rate increases to ensure output is at its supply determined level. This mitigates the rise in the stock price somewhat but it does not completely undo it, since some of the interest rate response is absorbed by human capital wealth. (The last point is the difference from Caballero and Simsek (2017): here, "time-varying risk premium" translates into actual price movements because we have two different types of wealth and the "risk premium" varies only for one type of wealth.)

Next consider the determination of tradable and nontradable employment. Substituting $W_{a,0} = \overline{W}$ and $x_{a,0} = 0$ into Eqs. $(A.44)$ and $(A.45)$, we solve for aggregate nontradable and tradable employment as, respectively,

$$\begin{aligned} L_0^N &= \frac{(1-\alpha)\,\eta}{1+\delta}\left(H_0 + Q_0\right)/\overline{W} \\ L_0^T &= \frac{(1-\alpha)\,(1-\eta)}{1+\delta}\left(H_0 + Q_0\right)/\overline{W} - (1-\alpha)\,D_0 + \alpha\overline{L}_0. \end{aligned}$$

Combining this with Eq. $(A.48)$, we further obtain,

$$\begin{aligned} L_0^N &= (1-\alpha)\,\eta\left(\overline{L}_0 + D_0\right) \\ L_0^T &= (1-\alpha)\,(1-\eta)\left(\overline{L}_0 + D_0\right) - (1-\alpha)\,D_0 + \alpha\overline{L}_0 \end{aligned}$$

Finally, substituting $D_0 = \frac{\alpha}{1-\alpha}\overline{L}_0$ from Assumption D (which ensures that the share of capital is equal to α), we can further simplify these expressions as follows,

$$\begin{aligned} L_0^N &= \eta \overline{L}_0, \\ L_0^T &= (1-\eta)\,\overline{L}_0. \end{aligned} \tag{A.54}$$

Hence, the share of labor in the nontradable and tradable sectors is determined by the share of the corresponding good in household spending.

Proposition 1. *Consider the model with Assumption D when areas have common stock wealth, $x_{a,0} = 0$ for each a. In equilibrium, all areas have identical allocations and prices. In period 0, labor is equal to its frictionless level, $L_0 = \overline{L}_0$, that solves Eq. (A.38), and nominal wages and prices are given by $W_0 = \overline{W}$ and $P_0 = \overline{P} = D_0^{\alpha}\overline{W}$. The nominal interest rate is given by Eq. (A.51); human capital and stock wealth are given by Eqs. (A.52) and (A.53); the share of labor employed in the nontradable sector is equal to η [cf. Eq. (A.54)]. In particular, an increase in D_1 decreases increases the interest rate and the price of capital but do not affect the labor market outcomes in period 0.*

A.4 Log-linearized Equilibrium with Heterogeneous Stock Wealth

We next consider the case with a more general distribution of stock wealth, $\{x_{a,0}\}_a$, that satisfies $\int_a x_{a,0}da = 0$. In this case, we log-linearize the equilibrium conditions around the common-wealth benchmark (for a fixed level of D_1), and we characterize the log-linearized equilibrium. To this end, we define the log-deviations of the local equilibrium variables around the common-wealth benchmark: $y = \log\left(Y/Y^b\right)$, where $Y \in \left\{L_{a,0}, L_{a,0}^N, L_{a,0}^T, W_{a,0}, P_{a,0}, U_{a,0}, H_{a,0}\right\}_a$. We also define the log-deviations of the endogenous aggregate variables: $y = \log\left(Y/Y^b\right)$, where $Y \in \left\{P_t^T, R_t, Q_t, R^f\right\}$. The following lemma simplifies the analysis (proof omitted).

Lemma 3. *Consider the log-linearized equilibrium conditions around the common-wealth benchmark. The solution to these equations satisfies $\int_a l_{a,0}da = \int_a w_{a,0}da = 0$ and $p_t^T = r_t = q_0 = r^f = 0$. In particular, the log-linearized equilibrium outcomes for the aggregate variables are the same as their counterparts in the common-wealth benchmark.*

We next log-linearize the equilibrium conditions and characterize the log-linearized equilibrium outcomes for each area a. We start with Eqs. (A.30) that characterize the other prices in terms of nominal wages in an area. Log-linearizing the first equation in (A.30), we obtain,

$$p_{a,0}^N = u_{a,0} = (1-\alpha)\,w_{a,0}. \tag{A.55}$$

Log-linearizing the ideal price index (A.9), we further obtain:

$$p_{a,0} = \eta p_{a,0}^N = \eta\,(1-\alpha)\,w_{a,0}. \tag{A.56}$$

Next, we log-linearize the labor supply equation $(A.19)$ to obtain:

$$w_{a,0} = \frac{\lambda_w}{1+\varphi\varepsilon_w}\left(p_{a,0} + \varphi\varepsilon_w w_{a,0} + \varphi l_{a,0}\right).$$

After rearranging terms and simplifying, we obtain Eq. (4) from the main text:

$$w_{a,0} = \lambda\left(p_{a,0} + \varphi l_{a,0}\right), \text{ where } \lambda = \frac{\lambda_w}{1+\left(1-\lambda_w\right)\varphi\varepsilon_w}. \tag{A.57}$$

Note that we derive the wage flexibility parameter, λ, in terms of the more structural parameters, $\lambda_w, \varphi, \varepsilon_w$. As expected, wage flexibility is greater when a greater fraction of members adjust wages (greater λ_w), labor supply is more inelastic (greater φ), labor types are less substitutable (smaller ε_w).

Note also that, combining Eqs. $(A.56)$ and $(A.57)$, we obtain the simplified labor supply equation:

$$w_{a,0} = \kappa l_{a,0}, \text{ where } \kappa = \frac{\lambda\varphi}{1-\lambda\eta\left(1-\alpha\right)}. \tag{A.58}$$

As expected, the wage adjustment parameter, κ, depends on the wage flexibility parameter, λ, and the inverse elasticity of the labor supply, φ. It also depends on the share of nontradables and the share of labor, $\eta, 1-\alpha$, as these parameters capture the extent to which a change in local wages translate into local inflation, which creates further wage pressure.

Next, we log-linearize the labor demand equation $(A.47)$ to obtain,

$$\begin{aligned}\left(w_{a,0}+l_{a,0}\right)\overline{WL}_0 &= \frac{\left(1-\alpha\right)\eta}{1+\delta}\Big(\left(w_{a,0}+l_{a,0}\right)\overline{WL}_0 + x_{a,0}Q_0\Big) \\ &\quad -\left(\varepsilon-1\right)\left(1-\alpha\right)w_{a,0}\overline{W}L_0^T.\end{aligned} \tag{A.59}$$

Here, the second line uses $u_{a,0} = \left(1-\alpha\right)w_{a,0}$ from Eq. $(A.55)$.

After rearranging terms, we further obtain the simplified labor demand equation:

$$\begin{aligned}\left(w_{a,0}+l_{a,0}\right)\overline{WL}_0 &= \mathcal{M}\left(\frac{\left(1-\alpha\right)\eta}{1+\delta}x_{a,0}Q_0 - \left(\varepsilon-1\right)\left(1-\alpha\right)w_{a,0}\overline{W}L_0^T\right), \\ \text{where } \mathcal{M} &= \frac{1}{1-\left(1-\alpha\right)\eta/\left(1+\delta\right)}\end{aligned} \tag{A.60}$$

Here, we defined the parameter, $\mathcal{M}$, which captures the local Keynesian multiplier effects.

For each a, Eqs. $(A.60)$ and $(A.58)$ represent 2 equations in 2 unknowns, $(w_{a,0}, l_{a,0})$. Hence, these equations characterize the local labor market outcomes in the log-linearized equilibrium.

Solving these equations, we also obtain the following closed-form characterization,

$$w_{a,0} + l_{a,0} = \frac{1+\kappa}{1+\kappa\zeta}\mathcal{M}\frac{\left(1-\alpha\right)\eta}{1+\delta}\frac{x_{a,0}Q_0}{\overline{WL}_0} \tag{A.61}$$

$$l_{a,0} = \frac{1}{1+\kappa}\left(w_{a,0}+l_{a,0}\right) \tag{A.62}$$

$$
\begin{aligned}
w_{a,0} &= \frac{\kappa}{1+\kappa}\left(w_{a,0}+l_{a,0}\right), \qquad \text{(A.63)}\\
\text{where } \zeta &= 1+(\varepsilon-1)(1-\alpha)\frac{L_0^T}{\overline{L}_0}\mathcal{M}\\
&= 1+(\varepsilon-1)(1-\alpha)(1-\eta)\mathcal{M}.
\end{aligned}
$$

Here, the second-to-last line defines the parameter, ζ, and the last line substitutes $\frac{L_0^T}{\overline{L}_0} = 1-\eta$ [cf. Eq. $(A.54)$]. Eq. $(A.61)$ illustrates that the local spending on nontradables affects the local labor bill. Eqs. $(A.62)$ and $(A.63)$ illustrate that this also affects employment and wages according to the wage flexibility parameter, κ.

The term, $\frac{1+\kappa}{1+\kappa\zeta}$, in Eq. $(A.61)$ captures the effect that works through exports. In particular, an increase in local spending increases local wages, which generates an adjustment of local exports. As expected, this adjustment is stronger when wages are more flexible (higher κ). The adjustment is also stronger when tradable inputs are more substitutable across regions (higher ε, which leads to higher ζ). In fact, when tradable inputs are gross substitutes ($\varepsilon > 1$, which leads to $\zeta > 1$), the export adjustment dampens the direct spending effect on the labor bill. When tradable inputs are gross complements ($\varepsilon < 1$, which leads to $\zeta < 1$), the export adjustment amplifies the direct spending effect.

Finally, consider the effect on local labor employed in nontradable and tradable sectors. First consider the tradable sector. Log-linearizing Eq. $(A.45)$ (after substituting for H_0 from Eq. $(A.40)$), and simplifying the expression as before, we obtain an expression for the labor bill in the tradable sector,

$$
\begin{aligned}
w_{a,0}+l_{a,0}^T &= -(\varepsilon-1)(1-\alpha)\,w_{a,0}\\
&= -(\varepsilon-1)(1-\alpha)\frac{\kappa}{1+\kappa\zeta}\mathcal{M}\frac{(1-\alpha)\eta}{1+\delta}\frac{x_{a,0}Q_0}{\overline{WL}_0}. \qquad \text{(A.64)}
\end{aligned}
$$

Here, the second line uses Eq. $(A.63)$. These expressions illustrate that the export adjustment described above affects the tradable labor bill. While the effect of stock wealth on the tradable labor bill is ambiguous (as it depends on whether $\varepsilon > 1$ or $\varepsilon < 1$), we show that the effect on tradable employment is always (weakly) negative, $dl_{a,0}^T/dx_{a,0} \leq 0$. Intuitively, the increase in local wages always generate some substitution of labor away from the area. On the other hand, labor bill can increase or decrease depending on the strength of the income effect relative to this substitution effect.

Next consider the nontradable sector. Log-linearizing Eq. $(A.47)$ (after substituting for $H_{a,0}$ from Eq. $(A.40)$), and simplifying the expression as before, we obtain an expression for the labor bill in the nontradable sector,

$$
w_{a,0}+l_{a,0}^N = \frac{1}{\overline{WL}_0^N}\frac{(1-\alpha)\eta}{1+\delta}\left(\left(w_{a,0}+l_{a,0}\right)\overline{WL}_0+x_{a,0}Q_0\right)
$$

$$
\begin{aligned}
&= \frac{1}{\overline{WL}_0^N}\frac{(1-\alpha)\,\eta}{1+\delta}\left(\left(w_{a,0}+l_{a,0}^N\right)\overline{WL}_0^N+\left(w_{a,0}+l_{a,0}^T\right)\overline{WL}_0^T+x_{a,0}Q_0\right)\\
&= \frac{1}{\overline{WL}_0^N}\mathcal{M}\frac{(1-\alpha)\,\eta}{1+\delta}\left(\left(w_{a,0}+l_{a,0}^T\right)\overline{WL}_0^T+x_{a,0}Q_0\right)\\
&= \frac{1}{\eta\overline{WL}_0}\mathcal{M}\frac{(1-\alpha)\,\eta}{1+\delta}\left(\left(w_{a,0}+l_{a,0}^T\right)(1-\eta)\,\overline{WL}_0+x_{a,0}Q_0\right)\\
&= \mathcal{M}\frac{1-\alpha}{1+\delta}\left(\frac{x_{a,0}Q_0}{\overline{WL}_0}+(1-\eta)\left(w_{a,0}+l_{a,0}^T\right)\right) \qquad \text{(A.65)}
\end{aligned}
$$

Here, the second line separates the expression for the total labor bill into the labor bill for nontradable and tradable sectors. The third line accounts for the multiplier effects through the nontradable labor bill. The fourth line uses Eq. $(A.54)$ to substitute $\overline{L}_0^N=\eta\overline{L}_0$ and $\overline{L}_0^T=(1-\eta)\,\overline{L}_0$. The last line simplifies and rearranges terms.

Eq. $(A.65)$ illustrates that greater stock wealth affects the nontradable labor bill due to a direct and an indirect effect. The direct effect is positive as it is driven by the impact of greater local wealth on local spending. There is also an indirect effect due to the impact of the stock wealth on the tradable labor bill (which in turn affects local labor income). The indirect effect has an ambiguous sign because stock wealth can decrease or increase the tradable labor bill depending on ε (cf. Eq. $(A.64)$). Nonetheless, we show that the direct effect always dominates. Specifically, regardless of ε, we have $d\left(w_{a,0}+l_{a,0}^N\right)/dx_{a,0}>0, dl_{a,0}^N/dx_{a,0}>0$: that is, greater stock wealth increases the nontradable labor bill as well as nontradable employment. The following result summarizes this discussion.

Proposition 2. *Consider the model with Assumption D when areas have an arbitrary distribution of stock wealth, $\{x_{a,0}\}_a$, that satisfies $\int_a x_{a,0}da=0$. In the log-linearized equilibrium, local labor and wages in a given area,$(l_{a,0},w_{a,0})$, are characterized as the solution to Eqs. $(A.60)$ and $(A.58)$. The solution is given by Eqs. $(A.62)$ and $(A.63)$. Local labor bill in nontradables and tradable sectors are given by Eqs. $(A.64)$ and $(A.65)$. In particular, local employment and wages satisfy the following comparative statics with respect to stock wealth:*

$$dl_{a,0}/dx_{a,0}>0, dw_{a,0}/dx_{a,0}\geq 0 \text{ and } d\left(l_{a,0}+w_{a,0}\right)/dx_{a,0}>0.$$

Moreover, regardless of ε, employment and the labor bill in nontradable and tradable sectors satisfy the following comparative statics:

$$d\left(l_{a,0}^N+w_{a,0}\right)/dx_{a,0}>0, dl_{a,0}^N/dx_{a,0}>0 \text{ and } dl_{a,0}^T/dx_{a,0}\leq 0.$$

Proof. Most of the proof is presented earlier. It remains to establish the comparative statics for the tradable employment, the nontradable employment and the nontradable labor bill.

First consider the tradable employment. Note that the first line of the expression in $(A.64)$

implies

$$l^T_{a,0} = -\left(1 + (\varepsilon - 1)(1-\alpha)\right) w_{a,0}. \tag{A.66}$$

Since $(\varepsilon - 1)(1-\alpha) > -1$ (because $\varepsilon > 0$) and $dw_{a,0}/dx_{a,0} \geq 0$ (cf. Eq. $(A.63)$), this implies the comparative statics for the tradable employment, $dl^T_{a,0}/dx_{a,0} \leq 0$.

Next consider the nontradable employment. Note that $L_{a,0} = L^T_{a,0} + L^N_{a,0}$. Log-linearizing this expression, we obtain,

$$l^N_{a,0} L^N_{a,0} = l_{a,0} \overline{L}_0 - l^T_{a,0} L^T_{a,0}.$$

Differentiating this expression with respect to $x_{a,0}$ and using $dl_{a,0}/dx_{a,0} > 0$ and $dl^T_{a,0}/dx_{a,0} \leq 0$, we obtain the comparative statics for the nontradable employment, $dl^N_{a,0}/dx_{a,0} > 0$. Combining this with $dw_{a,0}/dx_{a,0} \geq 0$, we further obtain the comparative statics for the nontradable labor bill, $d\left(l^N_{a,0} + w_{a,0}\right)/dx_{a,0} > 0$. □

A.5 Comparative Statics of Local Labor Market Outcomes

We next combine our results to investigate the impact of a change in aggregate stock wealth (over time) on local labor market outcomes. Specifically, consider the comparative statics of an increase in capital productivity from some D^{old}_1 to $D^{new}_1 > D^{old}_1$.

First consider the effect on the common-wealth benchmark. By Proposition 1, the equilibrium price of capital increases from Q^{old}_1 to $Q^{new}_1 > Q^{old}_1$. The labor market outcomes remain unchanged: in particular, $L_0 = \overline{L}_0, W_0 = \overline{W}, L^T_0 = \eta \overline{L}_0, L^N_0 = (1-\eta)\overline{L}_0$.

Next consider the effect when areas have heterogeneous wealth. We use the notation $\Delta X = X^{new} - X^{old}$ for the comparative statics on variable X. Consider the effect on labor market outcomes, for instance, the (log of the) local labor bill $\log(W_{a,0} L_{a,0})$. Note that we have:

$$\log(W_{a,0} L_{a,0}) \simeq \log\left(\overline{W} L_0\right) + w_{a,0} + l_{a,0}.$$

Here, $w_{a,0}, l_{a,0}$ are characterized by Proposition 2 as linear functions of capital ownership, $x_{a,0}$; and the approximation holds up to second-order terms in capital ownership, $\{x_{a,0}\}_a$. Note also that the change of D_1 does not affect $\log\left(\overline{W} L_0\right)$. Therefore, the comparative statics in this case can be written as,

$$\begin{aligned} \Delta \log(W_{a,0} L_{a,0}) &\simeq \Delta\left(w_{a,0} + l_{a,0}\right) \\ &= \left(w^{new}_{a,0} + l^{new}_{a,0}\right) - \left(w^{old}_{a,0} + l^{old}_{a,0}\right), \end{aligned}$$

where the approximation holds up to second-order terms in $\{x_{a,0}\}_a$. Put differently, up to second-order terms, the change of D_1 affects the (log of the) local labor bill through its effect on the log-linearized equilibrium variables.

Recall that the log-linearized equilibrium is characterized by Proposition 2. In particular, considering Eq. $(A.61)$ for D_1^{old} and D_1^{new}, we obtain:

$$
\begin{aligned}
w_{a,0}^{old} + l_{a,0}^{old} &= \frac{1+\kappa}{1+\kappa\zeta}\mathcal{M}\frac{(1-\alpha)\,\eta}{1+\delta}\frac{x_{a,0}Q_0^{old}}{\overline{WL}_0}, \\
w_{a,0}^{new} + l_{a,0}^{new} &= \frac{1+\kappa}{1+\kappa\zeta}\mathcal{M}\frac{(1-\alpha)\,\eta}{1+\delta}\frac{x_{a,0}Q_0^{new}}{\overline{WL}_0}.
\end{aligned}
$$

These equations illustrate that the change of D_1 affects the log-linearized equilibrium only through its effect on the price of capital, Q_0. Taking their difference, we obtain Eq. (9) in the main text that describes $\Delta\left(w_{a,0} + l_{a,0}\right)$.

Applying the same argument to Eqs. $(A.62), (A.65), (A.64)$, we also obtain Eqs. $(10), (11), (12)$ in the main text that describe, respectively, $\Delta l_{a,0}, \Delta\left(w_{a,0} + l_{a,0}^N\right), \Delta\left(w_{a,0} + l_{a,0}^T\right)$. These equations illustrate that an increase in local stock wealth due to a change in aggregate stock wealth has the same impact on local labor market outcomes as an increase of stock wealth in the cross section that we characterized earlier.

A.6 Details of the Calibration Exercise

This appendix provides the details of the calibration exercise in Section 6. We start by summarizing the solution for the local labor market outcomes that we derived earlier. In particular, we use the change of variables, $\frac{1}{1+\delta} = \rho T$ and write the differenced versions of Eqs. $(A.61 - A.65)$ as follows:

$$
\begin{aligned}
\frac{\Delta\left(w_{a,0} + l_{a,0}\right)}{SR} &= \frac{1+\kappa}{1+\kappa\zeta}\mathcal{M}\left(1-\alpha\right)\eta\rho, \\
\frac{\Delta l_{a,0}}{SR} &= \frac{1}{1+\kappa}\frac{\Delta\left(w_{a,0} + l_{a,0}\right)}{SR} \qquad (A.67) \\
\frac{\Delta w_{a,0}}{SR} &= \frac{\kappa}{1+\kappa}\frac{\Delta\left(w_{a,0} + l_{a,0}\right)}{SR} \\
\frac{\Delta\left(w_{a,0} + l_{a,0}^T\right)}{SR} &= -\left(\varepsilon - 1\right)\left(1-\alpha\right)\frac{\Delta w_{a,0}}{SR} \\
\frac{\Delta\left(w_{a,0} + l_{a,0}^N\right)}{SR} &= \mathcal{M}\left(1-\alpha\right)\rho\left(1 - \left(\varepsilon - 1\right)\left(1-\alpha\right)\left(1-\eta\right)T\frac{\Delta w_{a,0}}{SR}\right) \qquad (A.68) \\
\text{where } S &= \frac{x_{a,0}Q_{a,0}}{\overline{WL}_0/T}, R = \frac{\Delta Q_0}{Q_0} \\
\text{and } \mathcal{M} &= \frac{1}{1-\left(1-\alpha\right)\eta\rho T} \\
\text{and } \zeta &= 1 + \left(\varepsilon - 1\right)\left(1-\alpha\right)\left(1-\eta\right)\mathcal{M}.
\end{aligned}
$$

Our calibration relies on two model equations that determine the key parameters κ and ρ. Specifically, we calibrate κ by using Eq. $(A.67)$, which replicates Eq. (19) from the main text. We calibrate ρ by using Eq. $(A.68)$ which generalizes Eq. (17) from the main text. For reasons we describe in the main text, we do not use the response of the tradable sector for calibration purposes (see Footnote 29).

Note that combining Eq. (A.67) with the empirical coefficients for employment and the total labor bill from Table 1 (for quarter 7), we obtain:

$$0.69\% \leq \frac{1}{1+\kappa} 2.25\%$$

As we discuss in the main text, while the model makes predictions for total labor supply including changes in hours per worker, in the data we only observe employment. A long literature dating to Okun (1962) finds an elasticity of total hours to employment of 1.5. Applying this adjustment and using the coefficients for total employment and the total labor bill from Table 1 yields:

$$\begin{aligned} \frac{\Delta l_{a,0}}{S_{a,0} R_0} &= 1.5 \times 0.69\% \\ \frac{\Delta \left(w_{a,0} + l_{a,0}\right)}{S_{a,0} R_0} &= 2.25\%. \end{aligned}$$

Combining these with Eq. (19), we obtain:

$$\kappa = 1.2. \tag{A.69}$$

Thus, a one percent change in labor is associated with a 1.2% change in wages at a horizon of two years.

That leaves us with Eq. (A.68) to determine the stock wealth effect parameter, ρ. In the main text, we focus on a baseline calibration that assumes unit elasticity for tradables, $\varepsilon = 1$, which leads to a particularly straightforward analysis. In this appendix, we first provide the details of the baseline calibration. We then show that this calibration is robust to considering a wider range for the tradable elasticity parameter, $\varepsilon \in [0.5, 1.5]$. Throughout, we set the parameter α so that the share of labor is equal to the standard empirical estimates:

$$1 - \alpha = \frac{2}{3}.$$

A.6.1 Details of the Baseline Calibration

Setting $\varepsilon = 1$ in Eq. (A.68) reduces to Eq. (17) in the main text,

$$\frac{\Delta \left(w_{a,0} + l_{a,0}^N\right)}{SR} = \mathcal{M} \left(1 - \alpha\right) \rho.$$

Combining this expression with the empirical coefficient for the nontradable labor bill from Table 1 (for quarter 7), we obtain:

$$\mathcal{M} \left(1 - \alpha\right) \rho = 2.83\%. \tag{A.70}$$

We also require the local income multiplier to be consistent with empirical estimates from the literature, which implies:

$$\mathcal{M}=\frac{1}{1-(1-\alpha)\,\rho\eta T}=1.5 \tag{A.71}$$

With these assumptions, as we discussed in the main text, Eq. $(A.70)$ determines the stock wealth effect parameter independently of the other parameters such as κ, η, T. In particular, we have:

$$\rho = 2.83\%.$$

Combining this with Eq. $(A.71)$ to match the multiplier, we also obtain:

$$\eta T = 17.67.$$

Hence, our calibration of the multiplier determines the product of η and T.

The parameter, η, is difficult to calibrate precisely because there is no good measure of the trade bill at the county level. Therefore, we allow for a wide range of possibilities:

$$\eta \in \left[\underline{\eta}, \overline{\eta}\right], \text{ where } \underline{\eta} = 0.5 \text{ and } \underline{\eta} = 0.8. \tag{A.72}$$

Then, our calibration of the multiplier implies:

$$T = T(\eta) \equiv \frac{17.67}{\eta}, \text{ where } T(\overline{\eta}) = 22.08 \text{ and } T\left(\underline{\eta}\right) = 35.34.$$

In particular, for every choice of η, there exists a horizon parameter T that supports the calibration of the multiplier in our model. Since our model is stylized in the time dimension (it has only two periods), we do not interpret T literally but view it as a modeling device to calibrate the multiplier $\mathcal{M}$. In particular, we view the implied high levels of T as capturing reasons outside our model (such as borrowing constraints) that would increase the income multiplier in practice.[3]

A.6.2 Robustness of the Baseline Calibration

Next consider the case with general ε. In this case, Eq. $(A.68)$ is more complicated and given by:

$$\frac{\Delta\left(w_{a,0}+l_{a,0}^{N}\right)}{SR} = \mathcal{M}\,(1-\alpha)\,\rho\left(1-(\varepsilon-1)\,(1-\alpha)\,(1-\eta)\,T\frac{\Delta w_{a,0}}{SR}\right).$$

In particular, the nontradable labor bill in this case also depends on the effect on local wages. The intuition is that the change in local wages affects the tradable labor bill, which affects local

[3]The dependence of $\mathcal{M}$ on T in our model can be understood by considering the intertemporal Keynesian cross (see Auclert et al. (2018) for an exposition). When output is determined by aggregate demand, an increase in future spending increases not only future income but also current income through a wealth effect. In our environment, increasing T increases the time-length of period 0 over which output is determined by aggregate demand. This leads to stronger multiplier effects.

households' income. This in turn affects local households' spending and the nontradable labor bill. Consistent with this intuition, the magnitude of this effect depends on the parameters $\varepsilon, \alpha, \eta$.[4]

Recall also that we have Eq. $(A.67)$ that describes the change in wages as a function of the change in the total labor bill:

$$\frac{\Delta w_{a,0}}{SR} = \frac{\kappa}{1+\kappa} \frac{\Delta \left(w_{a,0} + l_{a,0} \right)}{SR}.$$

Substituting this expression into Eq. $(A.68)$, and using the empirical coefficients for the nontradable and the total labor bill from Table 1 (for quarter 7), we obtain the following generalization of Eq. $(A.70)$:

$$\mathcal{M} \left(1-\alpha\right) \rho \left(1 - \left(\varepsilon - 1\right) \left(1-\alpha\right) \left(1-\eta\right) T \frac{\kappa}{1+\kappa} 2.25\% \right) = 2.83\%. \tag{A.73}$$

As this expression illustrates, the stock wealth effect parameter in this case is not determined independently of the remaining parameters, κ, η, T. We have already established that $\kappa = 1.2$ [cf. Eq. $(A.69)$]. We also assume η lies in the range $(A.72)$ that we described earlier. Recall also that we choose T to ensure Eq. $(A.71)$ given all other parameters. Hence, for any fixed ε, Eq. $(A.73)$ describes ρ as a function of η, where η is required to lie in the range $(A.72)$.

Figure A.1 illustrates the possible values of ρ for $\varepsilon = 0.5$ (the left panel) and $\varepsilon = 1.5$ (the right panel). As the figure illustrates the implied values for ρ remain close to their corresponding levels from the baseline calibration with $\varepsilon = 1$. As expected, the largest deviations from the benchmark obtain when the share of nontradables is small—as trade has the largest impact on households' incomes in this case. However, ρ lies within 10% of its corresponding level from the baseline calibration even if we set $\eta = 0.5$.

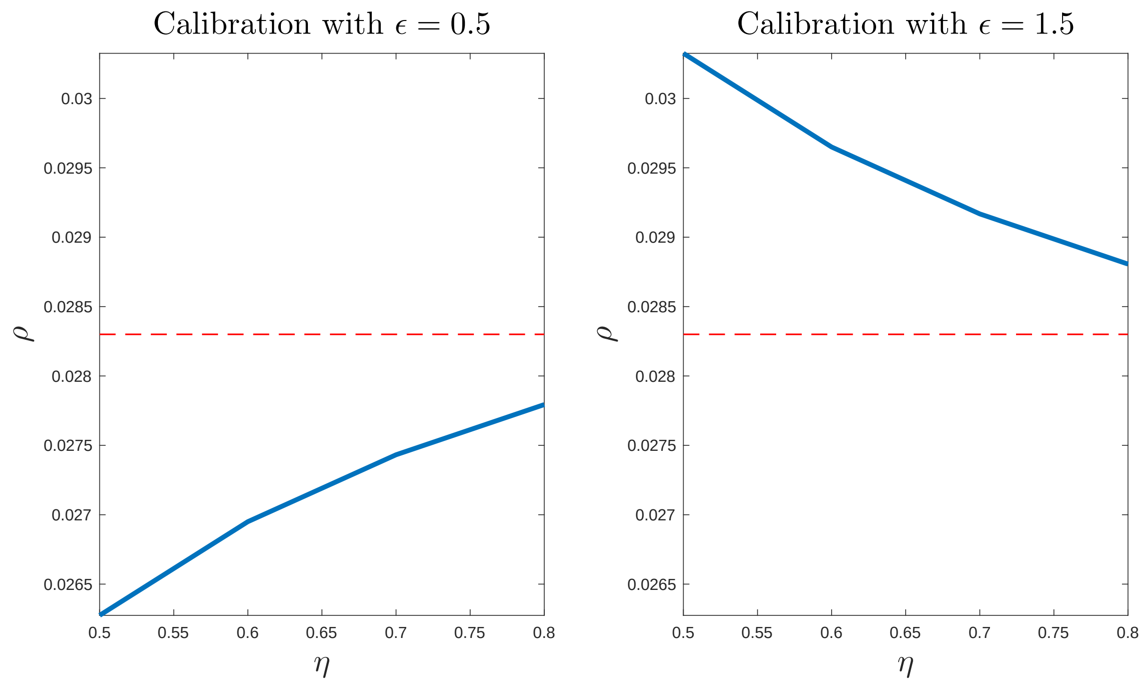
The intuition for robustness can be understood as follows. As we described earlier, the additional effects emerge from the adjustment of the tradable labor bill due to a change in local wages. As long as wages do not change by much, the effect has a negligible effect on our baseline calibration. As it turns out, the value of κ that we find given our calibration is such that the deviations from the benchmark are relatively small. Put differently, our analysis suggests that wages in an area do not change by much in response to stock wealth changes. Consequently, the tradable labor bill of the area also does not change by much either even if ε is somewhat different than 1.

A.7 Aggregation When Monetary Policy is Passive

So far, we assumed the monetary policy changes the interest rate to neutralize the impact of stock wealth changes on aggregate employment. In this appendix, we characterize the equilibrium under the alternative assumption that monetary policy leaves the interest rate unchanged in response to

[4]Less obviously, the magnitude also depends on the horizon parameter, T. This parameter enters the equation for the same reason it enters the equation for the multiplier, $\mathcal{M}$ (see Footnote 3). As before, the dependence of the equation on T can be thought of as capturing reasons outside our model (such as households' borrowing constraints) that would amplify the spending effect of any change in households' incomes due to trade considerations.

Figure A.1:



Notes: Notes: The left panel (resp. the right panel) illustrates the implied ρ as a function of η given $\varepsilon = 0.5$ (resp. $\varepsilon = 1.5$), as we vary η over the range in $(A.72)$. The red dashed lines illustrate the implied ρ for the baseline calibration with $\varepsilon = 1$.

stock price fluctuations. In Section 7 of the main text, we use this characterization together with our calibration to describe how stock price fluctuations would affect aggregate labor market outcomes if they were not countered by monetary policy.

The model is the same as in Section A.1 with the only difference that the monetary policy keeps the nominal interest rate at a constant level, $R^f = \overline{R}^f$. In particular, we continue to assume monetary policy stabilizes the long-run nominal wage at the constant level, $\overline{W}$. For simplicity, we also focus attention on the common-wealth benchmark, $x_{a,0} = 0$. Consequently, the areas have symmetric allocations that we denote by dropping the subscript a.

First note that the rental rate of capital is given by$R_0 = D_0 W_0$ [cf. Lemma 1]. Consequently, the analogues of Eqs. $(A.49)$ and $(A.50)$ also apply in this setting. In particular, human capital wealth is given by,

$$H_0 = W_0 L_0 + \frac{\overline{W L_1}}{\overline{R}^f} \tag{A.74}$$

and the stock wealth is given by,

$$Q_0 = W_0 D_0 + \frac{\overline{W} D_1}{\overline{R}^f}. \tag{A.75}$$

Next note that the labor demand Eq. $(A.46)$ applies also in this case. Using $x_{a,0} = 0$, we obtain,

$$W_0 L_0 = \frac{(1-\alpha)\,\eta}{1+\delta}\,(H_0 + Q_0) + \frac{(1-\alpha)\,(1-\eta)}{1+\delta}\,(H_0 + Q_0) - (1-\alpha)\,R_0 + \alpha W_0 L_0.$$

Using $R_0 = W_0 D_0$ and the expressions for H_0 from Eq. $(A.74)$, and collecting similar terms together, we obtain,

$$W_0 L_0 = \frac{1-\alpha}{1+\delta}\left(W_0 L_0 + \frac{\overline{WL}_1}{\overline{R}^f} + Q_0\right) - (1-\alpha) W_0 D_0 + \alpha W_0 L_0.$$

Simplifying further, we obtain,

$$W_0 L_0 + W_0 D_0 = \frac{1}{1+\delta}\left(W_0 L_0 + \frac{\overline{WL}_1}{\overline{R}^f} + Q_0\right). \tag{A.76}$$

This equation says that the total amount of spending in the aggregate (on capital and labor) depends on the lifetime wealth multiplied by the propensity to spend out of wealth.

Next note that the labor supply equation $(A.19)$ applies also in this case. Since areas have common wealth, we can rewrite this equation as:

$$W_0^{1-\varepsilon_w} = \lambda_w \left(\frac{\varepsilon_w}{\varepsilon_w - 1}\chi P_0 W_0^{\varepsilon_w \varphi} L_0^{\varphi}\right)^{(1-\varepsilon_w)/(1+\varphi\varepsilon_w)} + (1-\lambda_w)\overline{W}^{1-\varepsilon_w}. \tag{A.77}$$

Using Eq. $(A.30)$ and Lemma 1, we also have:

$$P_0 = W_0 D_0^{\alpha}. \tag{A.78}$$

The equilibrium is characterized by Eqs. $(A.75), (A.76), (A.77), (A.78)$ in four variables, (Q_0, W_0, L_0, P_0).

Next note that there exists a level of D_1, denoted by $\overline{D}_1$, that ensures these equations are satisfied with $L_0 = \overline{L}_0$ and $W_0 = \overline{W}$, along with $\overline{Q}_0 \equiv \overline{W} D_0 + \frac{\overline{WD}_1}{\overline{R}^f}$. To simplify the expressions further, we next log-linearize the equations around the equilibrium with $D_1 = \overline{D}_1$.

Log-linearized Aggregate Equilibrium. Log-linearizing the stock pricing Eq. $(A.75)$, we obtain,

$$q_0 \overline{Q}_0 = w_0 \overline{W} D_0 + d_1 \frac{\overline{WD}_1}{\overline{R}^f}. \tag{A.79}$$

Log-linearizing the labor demand Eq. $(A.76)$, we obtain,

$$(w_0 + l_0)\overline{WL}_0 + w_0 \overline{W} D_0 = \frac{1}{1+\delta}\left((w_0 + l_0)\overline{WL}_0 + q_0 \overline{Q}_0\right).$$

After substituting Eq. $(A.79)$, and rearranging terms to account for the multiplier effects, we further obtain,

$$\begin{aligned} (w_0 + l_0)\overline{WL}_0 + w_0 \overline{W} D_0 &= \tilde{\mathcal{M}}^A \frac{1}{1+\delta} d_1 \frac{\overline{WD}_1}{\overline{R}^f}, \\ \text{where } \tilde{\mathcal{M}}^A &= \frac{1}{1 - 1/(1+\delta)}. \end{aligned} \tag{A.80}$$

Log-linearizing the labor supply equation $(A.77)$, we obtain:

$$w_0 = \lambda\left(p_0 + \varphi l_0\right), \text{ where } \lambda = \frac{\lambda_w}{1 + \left(1 - \lambda_w\right)\varphi\varepsilon_w}. \tag{A.81}$$

Log-linearizing Eq. $(A.78)$, we obtain:

$$p_0 = w_0. \tag{A.82}$$

Combining the last two equations, we further obtain:

$$w_0 = \kappa^A l_0, \text{ where } \kappa^A \equiv \frac{\lambda\varphi}{1-\lambda} > \kappa = \frac{\lambda\varphi}{1 - \lambda\eta\left(1-\alpha\right)}. \tag{A.83}$$

The log-linearized equilibrium is characterized by Eqs. $(A.79), (A.80), (A.83)$ in three variables (q_0, w_0, l_0). Given these variables, we also characterize the price level as $p_0 = w_0$ [cf. $(A.82)$]. The equations for (q_0, w_0, l_0) can also be solved in closed form. We conjecture a linear solution:

$$\begin{aligned} q_0 \overline{Q}_0 &= A_Q Q^A \\ w_0 \overline{WL}_0 &= A_W Q^A \\ l_0 \overline{WL}_0 &= A_L Q^A, \\ \text{where } Q^A &= \frac{\overline{WD}_1 d_1}{\overline{R}^f} \end{aligned} \tag{A.84}$$

Here, Q^A denotes the log-linear approximation to the exogenous component of stock wealth $(\frac{\overline{W}D_1}{\overline{R}^f})$. Hence, the coefficients A_Q, A_W, A_L describe the effect of a one dollar increase in the exogenous component of stock wealth on endogenous equilibrium outcomes.

To solve for these coefficients, we substitute the linear functional form in $(A.84)$ into Eqs. $(A.79), (A.80), (A.83)$. We also use Assumption D to substitute $D_0 = \frac{\alpha}{1-\alpha}\overline{L}_0$ and simplify the expressions, to obtain the system of equations,

$$\begin{aligned} A_Q &= \frac{\alpha}{1-\alpha} A_W + 1 \\ A_W &= \kappa^A A_L \\ A_W + A_L + \frac{\alpha}{1-\alpha} A_W &= \tilde{\mathcal{M}}^A \frac{1}{1+\delta}. \end{aligned}$$

Using these equations, we obtain the closed-form solution for the effect on the aggregate labor bill,

$$\begin{aligned} A_W + A_L &= \mathcal{M}^A \frac{1-\alpha}{1+\delta}, \\ \text{where } \mathcal{M}^A &= \mathcal{F}^A \tilde{\mathcal{M}}^A \text{ and } \mathcal{F}^A = \frac{1+\kappa^A}{1-\alpha+\kappa^A} \end{aligned} \tag{A.85}$$

The effect on the aggregate employment and wages are given by

$$A_L = \frac{1}{1+\kappa^A}(A_W + A_L), \tag{A.86}$$

$$A_W = \frac{\kappa^A}{1+\kappa^A}(A_W + A_L). \tag{A.87}$$

Substituting the solutions in $(A.85 - A.87)$ into Eqs. $(A.84)$, we obtain

$$w_0 + l_0 = \mathcal{M}^A \frac{1-\alpha}{1+\delta} \frac{Q_0^A}{\overline{WL}_0}$$
$$l_0 = \frac{1}{1+\kappa^A}(w_0 + l_0).$$

Considering the equation for two different levels of future dividends, d_1^{old} and d_1^{new}, and taking the difference, we obtain Eqs. (21) and (22) in the main text.

Comparison with the Log-linearized Local Equilibrium. It is instructive to compare the log-linearized labor supply equations $(A.81)$ and $(A.83)$ with their counterparts in the local analysis. Note that Eq. $(A.81)$ is the same as its local counterpart, Eq. $(A.57)$. Hence, controlling for prices as well as labor, the aggregate labor supply curve is the same as the local one. However, Eq. $(A.83)$ is different than its local counterpart, Eq. $(A.58)$. This is because the impact of aggregate nominal wages on the aggregate price level is greater than the impact of local wages on the local price level: specifically, we have $p_0 = w_0$ as opposed to $p_{0,a} = w_{0,a}\eta(1-\alpha)$ [cf. Eqs. $(A.82)$ and $(A.56)$]. Therefore, the real wage $w - p$ responds locally but not in the aggregate. The real wage response generates a neoclassical local labor supply response, with strength determined by the magnitude of the Frish elasticity $1/\phi$, that does not extend to the aggregate level. Rewriting the expressions for κ and κ^A to eliminate the wage stickiness parameter, λ, we obtain:

$$\frac{1}{\kappa} = \frac{1}{\varphi}(1 - \eta(1-\alpha)) + \frac{1}{\kappa^A}.$$

This expression illustrates that the local labor response, $\frac{1}{\kappa}$, combines a neoclassical response to higher real wages, $\frac{1}{\varphi}(1-\eta(1-\alpha))$, that only occurs locally, and a term due to wage stickiness that extends to the aggregate, $\frac{1}{\kappa^A}$.

It is also instructive to consider the intuition for the labor bill characterized in $(A.85)$. Note that $1/(1+\delta)$ describes the effect of stock wealth on total spending. Multiplying this with $1-\alpha$ gives the direct effect on the aggregate labor bill. This direct effect is amplified by two types of multipliers. First, there is a standard aggregate spending multiplier captured by, $\tilde{\mathcal{M}}^A = \frac{1}{1-1/(1+\delta)} > 1$. Second, there is also a second multiplier, which we refer to as the *factor-share multiplier*, denoted by $\mathcal{F}^A = \frac{1+\kappa}{1-\alpha+\kappa} > 1$. The multiplier we use in the main text, $\mathcal{M}^A = \mathcal{F}^A\tilde{\mathcal{M}}^A$, is a composite of the two multipliers. The factor-share multiplier is somewhat specific to our model. In particular, it emerges from the assumption that wages are somewhat sticky but the rental rate of capital is not. Conversely, labor is somewhat flexible but capital is not. These features (combined with the production technologies we work with) implies that labor absorbs a greater fraction of demand-driven fluctuations in aggregate spending compared to capital. Consistent with this intuition, the factor-share multiplier is decreasing in the degree of wage flexibility, κ, and it approaches one in the limit with perfectly flexible wages, $\kappa \to \infty$.

Finally, we compare the aggregate effect in (A.85) with its local counterpart characterized earlier. Specifically, recall that Eqs. (A.62) and (A.63) imply the effect of stock wealth on the *local* labor bill is given by,

$$\frac{(l_{a,0} + w_{a,0})\,\overline{WL}_0}{x_{a,0}Q_0} = \mathcal{M}\frac{1+\kappa}{1+\kappa\zeta}\frac{(1-\alpha)\,\eta}{1+\delta}. \tag{A.88}$$

Comparing this expression with Eq. (A.85) illustrates that the aggregate effect differs from the local effect for three reasons. First, the direct spending effect is greater in the aggregate than at the local level, $\frac{1-\alpha}{1+\delta} > \frac{\eta(1-\alpha)}{1+\delta}$. Intuitively, spending on tradables increases the labor bill in the aggregate but not locally. Second, the aggregate labor bill does not feature the export adjustment term, $\frac{1+\kappa}{1+\kappa\zeta}$, because this adjustment is across areas. Third, the multiplier is greater in the aggregate than at the local level, $\mathcal{M}^A > \mathcal{M}$. In particular, the standard spending multiplier is greater at the aggregate level, $\tilde{\mathcal{M}}^A > \mathcal{M}$, because spending on tradables (as well as the mobile factor, capital) generates a multiplier effect in the aggregate but not locally. The factor-share multiplier increases the aggregate multiplier further, $\mathcal{F}^A > 1$.

Note also that, as long as $\varepsilon \geq 1$, the aggregate effect is greater than the local effect. In this case, $\zeta \geq 1$ and thus the export adjustment also dampens the local effect relative to the aggregate effect. When $\varepsilon < 1$, the export adjustment tends to make the local effect greater than the aggregate effect. However, all other effects (captured by $\eta < 1$ and $\mathcal{M}^A > \mathcal{M}$) tend to make the aggregate effect greater than the local effect.

A.8 Extending the Model to Incorporate Uncertainty

In this appendix, we generalize the baseline model to introduce uncertainty about capital productivity in period 1. We show that changes in households' risk aversion or perceived risk generate the same qualitative effects on the price of capital (as well as on "rstar") as in our baseline model. Moreover, conditional on a fixed amount of change in the price of capital, the model with uncertainty features the same *quantitative* effects on local labor market outcomes. Therefore, this exercise illustrates that our baseline analysis is robust to generating stock price fluctuations from alternative channels than the change in expected stock payoffs that we consider in our baseline analysis.

The model is the same as in Section A.1 with two differences. First, an aggregate state $s \in S$ is realized at the beginning of period 1 with probability $\pi(s)$ (with $\sum_{s \in S} \pi(s) = 1$). States determine the productivity of the capital-only technology. We adopt the normalization,

$$D_1(s) = s, \tag{A.89}$$

so that the state is equal to the productivity of capital, and we assume that S is a finite subset of $\mathbb{R}_+$. The baseline model is the special case in which S has a single element. We denote the equilibrium allocations in period 1 as functions of s, e.g., $C_{a,1}(s)$ denotes the consumption in area a and period 1 conditional on the aggregate state s.

Second, to analyze the effect of risk aversion, we also consider Epstein-Zin preferences that are more general than time-separable log utility. Specifically, we replace the preferences in (1) with,

$$\begin{aligned} & \log C_{a,0} + \delta \log U_{a,1}, \\ \text{where } U_{a,1} &= \left(E\left[C_{a,1}(s)^{1-\gamma}\right]\right)^{1/(1-\gamma)}. \end{aligned} \tag{A.90}$$

Here, $U_{a,1}$ captures the household's (and particularly, the consumer's) certainty-equivalent consumption. The parameter γ captures her risk aversion. The baseline model is the special case with $\gamma = 1$. Note that we still assume the elasticity of intertemporal substitution is equal to one. The consumer chooses $C_{a,0}, S_{a,0}, 1 + x_{a,1}$ to maximize $(A.90)$ subject to the budget constraints:

$$\begin{aligned} P_{a,0}C_{a,0} + S_{a,0} &= W_{a,0}L_{a,0} + (1 + x_{a,0}) Q_0 \\ S_{a,0} &= S^f_{a,0} + (1 + x_{a,1})(Q_0 - R_0) \\ P_{a,1}(s) C_{a,1}(s) &= \overline{W} L_{a,1}(s) + (1 + x_{a,1}) R_1(s) + S^f_{a,0} R^f. \end{aligned} \tag{A.91}$$

In period 0, the budget constraint is the same as before. In period 1, there is a separate budget constraint for each state. The rest of the equilibrium is unchanged.

General Characterization of Equilibrium with Uncertainty. Most of our analysis from the baseline case applies also in this case. First consider the equilibrium in period 1. As before, we have $W_{a,1}(s) \equiv \overline{W}$ and $L_{a,1}(s) = \overline{L}_1$ for each a and s. Using Lemma 1, we also obtain the following analogue of Eq. $(A.37)$

$$R_1(s) = D_1(s)\overline{W}. \tag{A.92}$$

Note also that aggregating the budget constraint across all areas, we obtain the aggregate budget constraint:

$$\int_a P_{a,1}(s) C_{a,1}(s) \, da = R_1(s) + \overline{W}\overline{L}_1.$$

By Lemma 1, the price of the consumption good is the same across areas,

$$P_{a,1}(s) = P_1(s) \equiv D_1(s)^{\alpha} \overline{W}.$$

After substituting this expression and using $(A.92)$, the aggregate budget constraint implies,

$$\int_a C_{a,1}(s) \, da = \frac{D_1(s) + \overline{L}_1}{(D_1(s))^{\alpha}}. \tag{A.93}$$

In the common-wealth benchmark, the areas are identical so Eq. $(A.93)$ provides a closed-form solution for consumption.

Next consider the equilibrium in period 0. The following lemma characterizes the consumers' optimal consumption and portfolio choice. To state the result let $H_{a,0} = W_{a,0}L_{a,0} + \frac{\overline{WL}_1}{R^f}$ denote the human capital wealth in area a as in the baseline model.

Lemma 4. *The optimal consumption for area a satisfies,*

$$P_{a,0}C_{a,0} = \frac{1}{1+\delta}\left[H_{a,0} + (1 + x_{a,0})\, Q_0\right]. \tag{A.94}$$

Optimal portfolios in area a are such that the risk-free interest rate satisfies,

$$1/R^f = E\left[M_{a,1}(s)\right] \tag{A.95}$$

and the price of capital satisfies,

$$Q_0 = R_0 + E\left[M_{a,1}(s)\, R_1(s)\right], \tag{A.96}$$

where $M_{a,1}(s)$ denotes the (nominal) stochastic discount factor *for area a and is given by*

$$M_{a,1}(s) = \delta \frac{P_{a,0}C_{a,0}}{P_{a,1}(s)\, C_{a,1}(s)} \frac{C_{a,1}(s)^{1-\gamma}}{E\left[C_{a,1}(s)^{1-\gamma}\right]}. \tag{A.97}$$

Eq. $(A.41)$ illustrates that the consumption wealth effect remains unchanged in this case [cf. Eq. $(A.41)$]. This is because we use Epstein-Zin preferences with an intertemporal elasticity of substitution equal to one. Eqs. $(A.95)$ and $(A.96)$ illustrate that standard asset pricing conditions apply in this setting. Specifically, the risk-free asset as well as capital are priced according to a stochastic discount factor (SDF) that might be specific to the area. Eq. $(A.97)$ characterizes the SDF. When $\gamma = 1$, the SDF has a familiar form corresponding to time-separable log utility. We relegate the proof of Lemma 4 to the end of this section.

Since the optimal consumption Eq. $(A.94)$ remains unchanged (and the remaining features of the model are also unchanged), the rest of the general characterization in Section A.2 also applies in this case. We next characterize the equilibrium further in the common-wealth benchmark.

Common-wealth Benchmark with Uncertainty. Consider the benchmark case with $x_{a,0} = 0$ for each a. We generalize Assumption D as follows.

Assumption $\mathbf{D}^{\mathrm{U}}$. $D_0 = \frac{\alpha}{1-\alpha}\overline{L}_0$ and $D_1(s) \geq \frac{\alpha}{1-\alpha}\overline{L}_1$ for each $s \in S$.

As before, this assumption ensures that $\tilde{K}_0^T = 0$ and $\tilde{K}_1^T(s) \geq 0$ for each s.

Note also that we still have $L_{a,0} = \overline{L}_0$ where $\overline{L}_0$ corresponds to the solution to $(A.38)$.

Next note that, since areas are identical, we have $C_{a,1}(s) = C_1(s)$. We also have $W_{a,1}(s) = \overline{W}$. By Lemma 1, this implies,

$$P_{a,1}(s) = (D_1(s))^{\alpha}\,\overline{W}. \tag{A.98}$$

Combining these observations with Eq. $(A.93)$, we obtain a closed-form solution for consumption,

$$C_1(s) = \frac{D_1(s) + \overline{L}_1}{(D_1(s))^{\alpha}}. \tag{A.99}$$

Next note that we also have $W_{a,0} = \overline{W}$, and

$$P_{a,0} = D_0^{\alpha}\overline{W}. \tag{A.100}$$

Therefore, the analogous equation also applies in period 0,

$$C_0 = \frac{D_0 + \overline{L}_0}{D_0^{\alpha}}. \tag{A.101}$$

Substituting this into Eq. $(A.94)$, and using $(A.100)$, we obtain,

$$\left(D_0 + \overline{L}_0\right)\overline{W} = \frac{1}{1+\delta}\left[H_{a,0} + Q_0\right].$$

After rearranging the expression, we find that Eq. $(A.48)$ also applies in this setting:

$$\left(H_0 + Q_0\right)/\overline{W} = (1+\delta)\left(\overline{L}_0 + D_0\right). \tag{A.102}$$

As before, the sum of capital and human capital wealth must be equal to a multiple of the frictionless output level. This is necessary so that the implied wealth effect is sufficiently large to clear the goods market.

Next note that, after substituting Eqs. $(A.99)$ and $(A.101)$ for consumption and Eqs. $(A.98)$ and $(A.100)$ for goods prices, we obtain a closed-form solution for the stochastic discount factor in $(A.97)$,

$$M_1(s) = \delta\frac{D_0 + \overline{L}_0}{D_1(s) + \overline{L}_1}\frac{\left(\frac{D_1(s)+\overline{L}_1}{(D_1(s))^{\alpha}}\right)^{1-\gamma}}{E\left[\left(\frac{D_1(s)+\overline{L}_1}{(D_1(s))^{\alpha}}\right)^{1-\gamma}\right]}. \tag{A.103}$$

Combining this expression with Eqs. $(A.95)$ and $(A.96)$, we also obtain closed-form solutions for $R^{f,*}$ ("rstar") and Q_0:

$$\begin{aligned} 1/R^{f,*} &= E\left[M_1(s)\right] && \text{(A.104)} \\ Q_0/\overline{W} &= D_0 + E\left[M_1(s)\,D_1(s)\right]. && \text{(A.105)} \end{aligned}$$

Here, the second line substitutes $R_0 = D_0\overline{W}$ and $R_1(s) = D_1(s)\,\overline{W}$. We can also calculate the human capital wealth as,

$$H_0/\overline{W} = \overline{L}_0 + \frac{\overline{L}_1}{R^f} = \overline{L}_0 + \overline{L}_1 E\left[M_1(s)\right]. \tag{A.106}$$

Note also that, when $\gamma = 1$, we have time-separable log utility and Eq. $(A.103)$ reduces to the more familiar form, $M_1(s) = \frac{D_0+\overline{L}_0}{D_1(s)+\overline{L}_1}$. Using this expression, note that, when there is a single state, Eqs. $(A.104)$ $(A.105)$, and $(A.106)$ become identical to their counterparts in the earlier analysis [cf. Eqs. $(A.51)$, $(A.53)$, and $(A.52)$].

Since the aggregate wealth $H_0 + Q_0$ remains unchanged (cf. $(A.102)$), the rest of the characterization in Section A.3 remains unchanged. In particular, labor shares in nontradable and tradable sectors are given by $L_0^N = \eta\overline{L}_0$ and $L_0^T = (1-\eta)\overline{L}_0$ [cf. Eq. $(A.54)$].

Recall that, in the baseline model without uncertainty, we generate fluctuations in Q_0 as well as R_f^* from changes in D_1. We next show that this aspect of the model also generalizes. In particular, after summarizing the above discussion, the following proposition establishes that changes in risk or risk aversion generate the same effects on asset prices as changes in future productivity in the baseline model. To state the result, recall that we normalize $D_1(s) = s$ so that the probability distribution for states, $\pi(s)$, is the same as the distribution for capital productivity.

Proposition 3. *Consider the model with uncertainty with Assumption D^U and the normalization in $(A.89)$ Suppose areas have common stock wealth, $x_{a,0} = 0$ for each a. In equilibrium, all areas have identical allocations and prices. In period 0, labor is at its frictionless level, $L_0 = \overline{L}_0$, and nominal wages are at their expected level, $W_0 = \overline{W}$; the stochastic discount factor is given by Eq. $(A.103)$; the nominal interest rate is given by Eq. $(A.104)$; the human capital and stock wealth are given by Eqs. $(A.106)$ and $(A.105)$; the share of labor employed in the nontradable sector is equal to η [cf. Eq. $(A.54)$].*

Consider any one of the following changes:

(i) Suppose $\gamma = 1$ and the probability distribution, $\left(\pi^{old}(s)\right)_{s\in S}$, changes such that $\left(\pi^{new}(s)\right)_{s\in S}$ first-order stochastically dominates $\left(\pi^{old}(s)\right)_{s\in S}$.

(ii) Suppose $\gamma = 1$ and the probability distribution, $\left(\pi^{old}(s)\right)_{s\in S}$, changes such that $\left(\pi^{old}(s)\right)_{s\in S}$ is a mean-preserving spread of $\left(\pi^{new}(s)\right)_{s\in S}$.

(iii) Suppose $(\pi(s))_s$ remains unchanged but risk-aversion decreases, $\gamma^{new} < \gamma^{old}$.

These changes increase Q_0 and reduce R_f^* in equilibrium but do not affect the labor market outcomes in period 0.

The first part is a generalization of the comparative statics exercise that we consider in the baseline model. It shows that the price of capital increases also if households perceive greater capital productivity in the first-order stochastic dominance sense. The second part shows that a similar result obtains if households' expected belief for capital productivity remains unchanged but they perceive less risk in capital productivity. For analytical tractability, these two parts focus on the case, $\gamma = 1$, which corresponds to time-separable log utility as in the baseline model. The last part considers the case with general γ, and shows that a similar result obtains also if households' belief distribution remains unchanged but their risk aversion declines. We relegate the proof of Proposition 3 to the end of this section.

Comparative Statics of Local Labor Market Outcomes with Uncertainty. Recall that since the optimal consumption Eq. $(A.94)$ remains unchanged, all equilibrium conditions for period 0 derived in Section A.2 continue to apply conditional on Q_0 and R^f. Therefore, the log-linearized equilibrium conditions derived in Section A.4 also continue to apply conditional on Q_0. Moreover, as we show in Section A.5, the comparative statics in Proposition 3 affect these conditions only through their effect on Q_0. It follows that, conditional on generating the same change in the price of capital, ΔQ_0, the model with uncertainty features the same *quantitative* effects on local labor market outcomes as in our our baseline model. Combining this result with the comparative static results in Proposition 3, we conclude that our baseline analysis is robust to generating stock price fluctuations from alternative sources such as changes in households' risk aversion or perceived risk about stock payoffs.

Proof of Lemma 4. To analyze the households' problem, we consider the change of variables,

$$\tilde{S}_{a,0} = S_{a,0} + \frac{\overline{WL_1}}{R^f}.$$

Note that $L_{a,1}(s) \equiv \overline{L}_1$. Hence, $\tilde{S}_{a,0}$ can be thought of as the households' "effective savings" that incorporates the present discounted value of her lifetime wealth. We also consider the change of variables

$$\omega_{a,1} \equiv \frac{(1 + x_{a,1})(Q_0 - R_0)}{\tilde{S}_{a,0}}.$$

Here, $\omega_{a,1}$ captures the fraction of households' effective savings that she invests in capital (recall that $Q_0 - R_0$ denotes the ex-dividend price of capital). The remaining fraction, $1 - \omega_{a,1}$, is invested in the risk-free asset. After substituting this notation into the budget constraints, the households' problem can be equivalently written as,

$$\begin{aligned}
\max_{\tilde{S}_{a,0},\omega_{a,1}} \quad & \log C_{a,0} + \delta \log U_{a,1}, && \text{(A.107)}\\
\text{where } U_{a,1} &= \left(E\left[C_{a,1}(s)^{1-\gamma}\right]\right)^{1/(1-\gamma)} \\
P_{a,0}C_{a,0} + \tilde{S}_{a,0} &= W_{a,0}L_{a,0} + \frac{\overline{WL_1}}{R^f} + (1 + x_{a,0})\,Q_0 \\
P_{a,1}(s)\,C_{a,1}(s) &= \tilde{S}_{a,0}\left(R^f + \omega_{a,1}\left(\frac{R_1(s)}{Q_0 - R_0} - R^f\right)\right)
\end{aligned}$$

Here, $\frac{R_1(s)}{Q_0 - R_0}$ denotes the gross return on capital. When $\omega_{a,1} = 0$, the household does not invest in capital so her portfolio return is the gross risk-free rate, R^f. When $\omega_{a,1} = 1$, the household invests all of her savings in capital so her portfolio return is the gross return to capital, $\frac{R_1(s)}{Q_0 - R_0}$.

Next consider the optimality condition for $\tilde{S}_{a,0}$ in problem $(A.107)$. This gives:

$$\begin{aligned} \frac{1}{P_{a,0}C_{a,0}} &= \delta E\left[\frac{U_{a,1}^{\gamma} C_{a,1}(s)^{-\gamma}}{U_{a,1}} \frac{1}{P_{a,1}(s)} \left(R^f + \omega_{a,1}\left(\frac{R_1(s)}{Q_0 - R_0} - R^f\right)\right)\right] \\ &= \delta E\left[U_{a,1}^{\gamma-1} C_{a,1}(s)^{-\gamma} \frac{C_{a,1}(s)}{\tilde{S}_{a,0}}\right] \\ &= \delta E\left[U_{a,1}^{\gamma-1} U_{a,1}^{1-\gamma} \frac{1}{\tilde{S}_{a,0}}\right] \\ &= \delta \frac{1}{\tilde{S}_{a,0}}. \end{aligned}$$

Here, the second line uses the budget constraint in period 1 to substitute for the return in terms of $C_{a,1}(s)$; the third line uses $U_{a,1}^{1-\gamma} = E\left[C_{a,1}(s)^{1-\gamma}\right]$ (from the definition of the certainty-equivalent return), and the last line simplifies the expression. Combining the resulting expression with the budget constraint in period 1, we obtain,

$$P_{a,0}C_{a,0} = \frac{1}{1+\delta}\left[W_{a,0}L_{a,0} + \frac{\overline{WL}_1}{R^f} + (1 + x_{a,0}) Q_0\right].$$

This establishes $(A.94)$.

Next, to establish the asset pricing condition for the risk-free asset, consider the optimality condition for $S_{a,0}^f$ in the original version of the problem (as this corresponds to saving in the risk-free asset). This gives:

$$\frac{1}{P_{a,0}C_{a,0}} = E\left[\frac{\delta}{P_{a,1}(s) C_{a,1}(s)^{\gamma} E\left[C_{a,1}(s)^{1-\gamma}\right]} R^f\right]. \tag{A.108}$$

Rearranging terms and substituting $M_{a,1}(s)$ from Eq. $(A.97)$, we obtain Eq. $(A.95)$. Finally, to establish the asset pricing condition for capital, consider the optimality condition for $\omega_{a,1}$ in problem $(A.107)$. This gives:

$$E\left[\frac{C_{a,1}(s)^{-\gamma}}{P_{a,1}(s)}\left(\frac{R_1(s)}{Q_0 - R_0} - R^f\right)\right] = 0.$$

Rearranging terms, we obtain,

$$\begin{aligned} Q_0 &= R_0 + \frac{1}{R^f E\left[\frac{1}{P_{a,1}(s) C_{a,1}(s)^{\gamma}}\right]} E\left[\frac{1}{P_{a,1}(s) C_{a,1}(s)^{\gamma}} R_1(s)\right] \\ &= R_0 + \delta E\left[\frac{P_{a,0}C_{a,0}}{P_{a,1}(s) C_{a,1}(s)^{\gamma} E\left[C_{a,1}(s)^{1-\gamma}\right]} R_1(s)\right] \end{aligned}$$

$$= \quad R_0 + E\left[M_1(s)\, R_1(s)\right].$$

Here, the second line uses Eq. (A.108) to simplify the expression and the last line substitutes for $M_1(s)$ from Eq. (A.97). This establishes (A.96) and completes the proof of the lemma. □

Proof of Proposition 3. It remains to establish the comparative statics exercises. Recall that the aggregate wealth and human capital wealth satisfy [cf. Eqs. (A.48) and (A.106)],

$$\begin{aligned}
(H_0 + Q_0)/\overline{W} &= (1+\delta)\left(\overline{L}_0 + D_0\right) \\
H_0/\overline{W} &= \overline{L}_0 + \frac{\overline{L}_1}{R^{f,*}}.
\end{aligned}$$

Note that the probability distribution, $(\pi(s))_{s \in S}$, or the risk aversion, γ, affect these equations only through their effect on Q_0 and R^f. These equations imply that if Q_0 increases in equilibrium, then $R^{f,*}$ must also increase. Specifically, the first equation implies that if Q_0 increases then H_0 decreases. The second equation implies that if H_0 decreases then $R^{f,*}$ increases. Therefore, it suffices to establish the comparative statics exercises for the price of capital, Q_0.

First consider the comparative statics exercises in parts (i) and (ii). After substituting $\gamma = 1$ and $D_1(s) = s$ into Eqs. (A.105) and (A.103), we obtain the following expression for the price of capital:

$$\begin{aligned}
Q_0 &= D_0 + \delta\left(D_0 + \overline{L}_0\right) E\left[f(s)\right], \\
\text{where } f(s) &= \frac{s}{s + \overline{L}_1}.
\end{aligned} \tag{A.109}$$

Here, the second line defines the function $f : \mathbb{R}_+ \to \mathbb{R}_+$. Note that this function is strictly increasing and strictly concave: that is, $f'(s) > 0$ and $f''(s) < 0$ for $s > 0$. Combining this observation with Eq. (A.109) proves the desired comparative statics. To establish (i), note that $E^{new}[f(s)] \geq E^{old}[f(s)]$ because $f(s)$ is increasing in s, and $\pi^{new}(s)$ first-order stochastically dominates $\pi^{old}(s)$. To establish (ii), note that $E^{new}[f(s)] \geq E^{old}[f(s)]$ because $f(s)$ is increasing and concave in s, and $\pi^{new}(s)$ second-order stochastically dominates $\pi^{old}(s)$ (which in turn follows because $\pi^{old}(s)$ is a mean-preserving spread of $\pi^{new}(s)$).

Finally, consider the comparative statics exercise in part (iii). In this case, Eqs. (A.105) and (A.103) imply,

$$Q_0 = D_0 + \delta\left(D_0 + \overline{L}_0\right) \frac{E\left[f(s)\, g(s)^{1-\gamma}\right]}{E\left[g(s)^{1-\gamma}\right]}, \tag{A.110}$$

$$\text{where } g(s) = \frac{s + \overline{L}_1}{s^{\alpha}}.$$

Here, the second line defines the function $g : \mathbb{R}_+ \to \mathbb{R}_+$. We first claim that this function is increasing in s over the relevant range. To see this, note that,

$$g'(s) = s^{-\alpha-1}\left((1-\alpha)s - \alpha\overline{L}_1\right).$$

Assumption D^{U} implies that $s \geq \frac{\alpha}{1-\alpha}\overline{L}_1$, which in turn implies $g'(s) \geq 0$. Therefore, $g(s)$ is increasing in s over the range implied by Assumption D^{U}.

Next note that Eq. $(A.110)$ can be rewritten as

$$Q_0 = D_0 + \delta\left(D_0 + \overline{L}_0\right) E^*\left[f(s)\right],$$

where $E^*[\cdot]$ denotes the expectations under the endogenous probability distribution $\{\pi_s^*\}_{s\in S}$, defined by,

$$\pi_s^* = \frac{\pi_s g(s)^{1-\gamma}}{\sum_{\tilde{s}\in S}\pi_{\tilde{s}} g(\tilde{s})^{1-\gamma}} \text{ for each } s \in S. \tag{A.111}$$

Hence, using our result from part (i), it suffices to show that $\pi_s^{*,new}$ (which corresponds to $\gamma^{new} < \gamma^{old}$) first-order stochastically dominates $\pi_s^{*,old}$.

To establish the last claim, define the cumulative distribution function corresponding to the endogenous probability distribution,

$$\Pi_s^*(\gamma) = \sum_{\tilde{s}\leq s}\pi_{\tilde{s}}^* = \frac{\sum_{\tilde{s}\leq s}\pi_{\tilde{s}} g(\tilde{s})^{1-\gamma}}{\sum_{\tilde{s}\in S}\pi_{\tilde{s}} g(\tilde{s})^{1-\gamma}} \text{ for each } s \in S. \tag{A.112}$$

We made the dependence of the distribution function on γ explicit. To prove the claim, it suffices to show that $\frac{d\Pi_s^*(\gamma)}{d\gamma} \geq 0$ for each $s \in S$ (so that a decrease in γ decreases $\Pi_s^*(\gamma)$ for each s and thus increases the distribution in the first-order stochastic dominance order). We have:

$$\begin{aligned}
\frac{d\Pi_s^*(\gamma)}{d\gamma} &= \frac{\sum_{\tilde{s}\leq s}\pi_{\tilde{s}} g(\tilde{s})^{1-\gamma}}{\sum_{\tilde{s}\in S}\pi_{\tilde{s}} g(\tilde{s})^{1-\gamma}}\left(-\frac{\sum_{\tilde{s}\leq s}\pi_{\tilde{s}} g(\tilde{s})^{1-\gamma}\log g(\tilde{s})}{\sum_{\tilde{s}\leq s}\pi_{\tilde{s}} g(\tilde{s})^{1-\gamma}} + \frac{\sum_{\tilde{s}\in S}\pi_{\tilde{s}} g(\tilde{s})^{1-\gamma}\log g(\tilde{s})}{\sum_{\tilde{s}\in S}\pi_{\tilde{s}} g(\tilde{s})^{1-\gamma}}\right) \\
&= \frac{\sum_{\tilde{s}\leq s}\pi_{\tilde{s}} g(\tilde{s})^{1-\gamma}}{\sum_{\tilde{s}\in S}\pi_{\tilde{s}} g(\tilde{s})^{1-\gamma}}\left(-\sum_{\tilde{s}\leq s}\frac{\pi_{\tilde{s}}^*}{\Pi_s^*(\gamma)}\log g(\tilde{s}) + \sum_{\tilde{s}\in S}\pi_{\tilde{s}}^*\log g(\tilde{s})\right) \\
&= \frac{\sum_{\tilde{s}\leq s}\pi_{\tilde{s}} g(\tilde{s})^{1-\gamma}}{\sum_{\tilde{s}\in S}\pi_{\tilde{s}} g(\tilde{s})^{1-\gamma}}\left(-E^*\left[\log g(\tilde{s}) \quad | \tilde{s} \leq s\right] + E^*\left[\log g(\tilde{s})\right]\right).
\end{aligned}$$

Here, the second line substitutes the definition of the endogenous distribution and its cumulative distribution from Eqs. $(A.111)$ and $(A.112)$. The last line substitutes the unconditional and conditional expectations. It follows that $\frac{d\Pi_s^*(\gamma)}{d\gamma} \geq 0$ for some $s \in S$ if and only if the unconditional expectation exceeds the conditional expectation, $E^*[\log g(\tilde{s})] \geq E^*[\log g(\tilde{s}) \mid \quad \tilde{s} \leq s]$. This is true because $\log g(s)$ is increasing in s (since $g(s)$ is increasing), which implies that the conditional expectation is increasing in s. This proves the claim and completes the proof of part (iii). $\square$

A.9 Extending the Model for More General EIS

We next generalize the model to consider more general levels of EIS. For simplicity, suppose all areas except for one have time-separable log utility (1) as in the baseline model. The remaining area, denoted by a, has the following more general utility function,

$$u\left(C_{a,0}\right)+\delta u\left(C_{a,1}\right) \text{ where } u\left(C\right)=\frac{\varepsilon}{\varepsilon-1}\left(C^{\frac{\varepsilon-1}{\varepsilon}}-1\right). \tag{A.113}$$

We characterize the equilibrium in area a and illustrate how it depends on the EIS parameter, ε. To simplify the analysis, we assume all other areas have equal wealth, $x_{\tilde{a},0}=0$ for each $\tilde{a}\neq a$. Since area a has zero mass, this ensures that the aggregate allocations and prices, as well as the allocations and prices in each area $\tilde{a}\neq a$, are described by the common-wealth benchmark characterized in Section A.7.

To characterize the equilibrium in area a, first note that (after substituting the equilibrium price for Q_0) households' budget constraints can be combined into a lifetime budget constraint,

$$P_{a,0}C_{a,0}+\frac{P_{a,1}C_{a,1}}{R^f}=H_{a,0}+\left(1+x_{a,0}\right)Q_0.$$

Households in area a maximize $(A.113)$ subject to this constraint. The optimality condition gives the Euler equation,

$$\begin{aligned} P_{a,1}C_{a,1} &= \delta^{\varepsilon}R^f\left(R^{fr}\right)^{\varepsilon-1}P_{a,0}C_{a,0} \\ \text{where } R_a^{fr} &= R^f\frac{P_{a,0}}{P_{a,1}} \end{aligned} \tag{A.114}$$

Here, R_a^{fr} denotes the real interest rate in area a. Substituting this into the budget constraint, we obtain the following analogue of Eq. (5),

$$P_{a,0}C_{a,0}=\frac{1}{1+\delta^{\varepsilon}\left(R_a^{fr}\right)^{\varepsilon-1}}\left(H_{a,0}+\left(1+x_{a,0}\right)Q_0\right),. \tag{A.115}$$

This expression illustrates that a similar relationship between wealth and consumption exists once we replace the exogenous parameter, δ, with its counterpart, $\delta^{\varepsilon}\left(R_a^{fr}\right)^{\varepsilon-1}$. When $\varepsilon=1$, the wealth-effect coefficient, $\frac{1}{1+\delta^{\varepsilon}\left(R_a^{fr}\right)^{\varepsilon-1}}$, does not depend on the real interest rate. In this case, which we analyze in the main text, the income and substitution effects are exactly balanced so that we have a pure wealth effect. When $\varepsilon>1$, the wealth-effect coefficient is decreasing in the interest rate. In this case, there is a net substitution effect so that greater interest rate increases savings and reduces consumption. Conversely, when $\varepsilon<1$, the wealth-effect coefficient is increasing in the interest rate due to a net-income effect.

To characterize the rest of the equilibrium, note that much of the analysis in Section A.2 applies also in this case. In particular, after using $x_{\tilde{a},0} = 0$ for each $\tilde{a}$, the labor demand equation in area a is given by the following analogue of Eq. $(A.47)$:

$$W_{a,0}L_{a,0} = \frac{(1-\alpha)\,\eta}{1+\delta^{\varepsilon}\left(R_a^{fr}\right)^{\varepsilon-1}}\left(W_{a,0}L_{a,0} + \frac{\overline{WL_1}}{R^f} + (1+x_{a,0})\,Q_0\right) + \left(\frac{U_{a,0}}{P_0^T}\right)^{1-\varepsilon}\overline{W}L_0^T$$

Here, recall that R_a^{fr} is given by Eq. $(A.114)$ where $P_{a,t} = \left(P_{a,t}^N\right)^{\eta}\left(P_{a,t}^T\right)^{1-\eta}$ and $P_{a,t}^N, P_{a,t}^T$ as well as $U_{a,t}$ are characterized by Lemma 1. Using $x_{\tilde{a},0} = 0$, we also have,

$$P_{a,t} = \left(\frac{W_{a,0}}{\overline{W}}\right)^{\eta(1-\alpha)} D_t^{\alpha}\overline{W} \text{ and } \frac{U_{a,0}}{P_0^T} = \left(\frac{W_{a,0}}{\overline{W}}\right)^{1-\alpha}.$$

After substituting these expressions, we simplify the labor demand equation as follows,

$$\begin{aligned} W_{a,0}L_{a,0} &= \frac{(1-\alpha)\,\eta}{1+\delta^{\varepsilon}\left(R_a^{fr}\right)^{\varepsilon-1}}\left(W_{a,0}L_{a,0} + \frac{\overline{WL_1}}{R^f} + (1+x_{a,0})\,Q_0\right) + \left(\frac{W_{a,0}}{\overline{W}}\right)^{(1-\alpha)(1-\varepsilon)}\overline{W}L_0^T, \\ \text{where } R_a^{fr} &= R^f\frac{D_0^{\alpha}}{D_1^{\alpha}}\left(\frac{W_{a,0}}{\overline{W}}\right)^{\eta(1-\alpha)}. \end{aligned}$$

The equilibrium in area a is characterized by solving this equation together with the labor supply equation $(A.19)$.

To make progress, consider the special case in which wages are perfectly sticky, $\lambda_w = 0$ (which also leads to $\lambda = 0$). In this case, $W_{a,0} = \overline{W}$ and the labor demand equation can be further simplified as,

$$\begin{aligned} \overline{W}L_{a,0} &= \frac{(1-\alpha)\,\eta}{1+\delta^{\varepsilon}\left(R^{fr}\right)^{\varepsilon-1}}\left(\overline{W}L_{a,0} + \frac{\overline{WL_1}}{R^f} + (1+x_{a,0})\,Q_0\right) + \overline{W}L_0^T, \\ \text{where } R^{fr} &= R^f\frac{D_0^{\alpha}}{D_1^{\alpha}}. \end{aligned} \tag{A.116}$$

Here, R^{fr} denotes the aggregate real interest rate. This expression illustrates that the labor market equilibrium in area a is characterized in similar fashion to the equilibrium in other areas. The main difference concerns the wealth-effect coefficient, $\frac{(1-\alpha)\eta}{1+\delta^{\varepsilon}\left(R^{fr}\right)^{\varepsilon-1}}$. The new coefficient illustrates that the level of the real interest rate affects the nontradable labor bill and thus also the total labor bill.

Next note that the aggregate equilibrium is unchanged and characterized as in Appendix A.7. In particular, the nominal interest rate is characterized by,

$$R^f = \frac{1}{\delta}\frac{\overline{L}_1 + D_1}{\overline{L}_0 + D_0}.$$

Thus, the real interest rate is characterized by,

$$R^{fr} = \frac{1}{\delta} \frac{\overline{L}_1 + D_1}{\overline{L}_0 + D_0} \frac{D_0^\alpha}{D_1^\alpha}.$$

Note that, we have:

$$\frac{dR^{fr}}{dD_1} = \frac{1}{\delta} \frac{D_0^\alpha}{\overline{L}_0 + D_0} D_1^{-\alpha-1} \left(-\alpha \overline{L}_1 + (1-\alpha) D_1\right) \geq 0,$$

where the inequality follows from Assumption D. Therefore, an increase in D_1 increases not only the nominal interest rate but also the real interest rate. Combining this observation with Eq. $(A.116)$ illustrates that a shock to D_1 that changes the price of capital has two effects on the labor markets in area a with high stock wealth, $x_{a,0}$. First, it creates a wealth effect as in the earlier analysis. Second, since it increases R^{fr}, it also creates a net substitution or income effect depending on whether $\varepsilon > 1$ or $\varepsilon < 1$.

B Data Appendix

B.1 Details on the IRS SOI

The IRS Statistics of Income (SOI) data reports tax return variables aggregated to the zip code for 2004-2015 (and selected years before) and to the county for 1989-2015. Beginning in 2010 for the county files and in all available years for zip code files, the data aggregate all returns filed by the end of December of the filing year. Prior to 2010, the county files aggregate returns filed by the end of September of the filing year, corresponding to about 95% to 98% of all returns filed in that year. In particular, the county files before 2010 exclude some taxpayers who file form 4868, which allows a six month extension of the filing deadline to October 15 of the filing year.[5] To obtain a consistent panel, we first convert the zip code files to a county basis using the HUD USPS crosswalk file. We then implement the following algorithm: (i) for 2010 onward, use the county files; (ii) for 2004-2009, use the zip code files aggregated to the county level and adjusted by the ratio of 2010 dividends in the county file to 2010 dividends in the zip code aggregated file; (iii) for 1989-2003, use the county file adjusted by the ratio of 2004 dividends as just calculated to 2004 dividends in the county files. We implement the same adjustment for labor income. We exclude from the baseline sample 74 counties in which the ratio of dividend income from the zip code files to dividend income

[5] See https://web.archive.org/web/20171019013107/https://www.irs.gov/statistics/soi-tax-stats-county-income-data-users-guide-and-record-layouts and https://web.archive.org/web/20190111012726/https://www.irs.gov/statistics/soi-tax-stats-individual-income-tax-statistics-zip-code-data-soi for data and documentation pertaining to the county and zip code files, respectively. For additional information on the timing of tax filings, see https://web.archive.org/web/20190211151353/https://www.irs.gov/newsroom/2019-and-prior-year-filing-season-statistics.

in the county files exceeds 2 between 2004 and 2009, as the importance of late filers in these counties makes the extrapolation procedure less reliable for the period before 2004.[6]

Finally, since our benchmark analysis is at the quarterly frequency and the SOI income data is yearly data, we linearly interpolate the SOI data to obtain a quarterly series. Because the cross-sectional income distribution is persistent, measurement error arising from this procedure should be small.

B.2 Measurement Error in Capitalization Approach

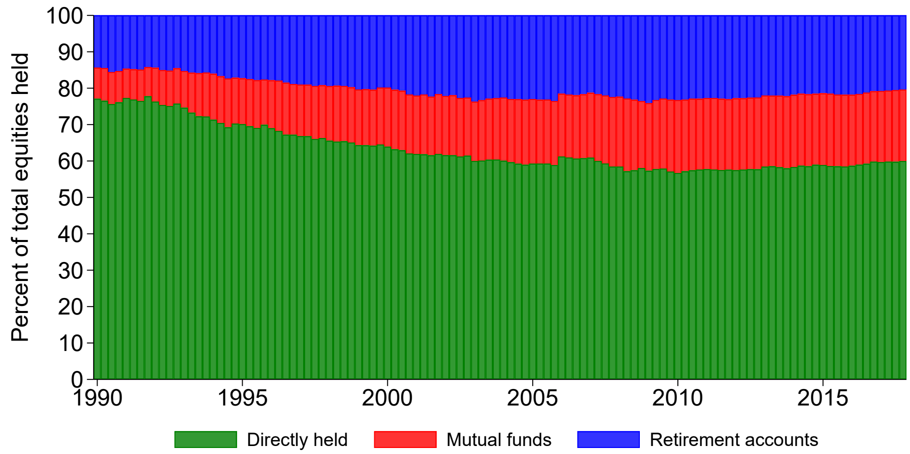
In this appendix we investigate three sources of potential measurement error arising from the capitalization approach and conclude the magnitude of measurement error is likely to be small.

Heterogeneous stock portfolios. The capitalization method implicitly assumes all counties hold the same stock market portfolio. In reality, households residing in different counties may hold different portfolios, for example due to home bias (Coval and Moskowitz, 1999) or differences in risk preferences. The aggregate price-dividend ratio and return used to construct $S_{a,t-1}R_{t-1,t}$ may then differ from the price-dividend ratio and return of the local portfolio. We can distinguish three cases. First, purely idiosyncratic differences in holdings (including due to home bias) would not affect our empirical results because they would give rise to idiosyncratic changes in wealth that are uncorrelated with our main regressor.[7] Second, high wealth areas may have systematically better portfolios in the sense of earning positive alpha, as suggested by Fagereng et al. (2016). County fixed effects will absorb this type of heterogeneity without biasing the estimated coefficients. Third, high wealth areas may have systematically riskier or less risky stock portfolios or systematic differences in the dividend payout ratio of their holdings. This dimension of heterogeneity would result in systematic under-counting (riskier, higher price-dividend ratio stocks) or over-counting (less risky, lower price-dividend ratio stocks) of changes in wealth in high wealth areas when the stock market

[6] Anecdotally, the filing extension option is primarily used by high-income taxpayers who may need to wait for additional information past the April 15 deadline (see e.g. Dale, Arden, "Late Tax Returns Common for the Wealthy," *Wall Street Journal*, March 29, 2013). Consistent with this, we find much less discrepancy in labor income than dividend income reported in the zip code and county files before 2010. Our results change little if we do not exclude the 74 counties from the analysis. For example, the coefficient for total payroll at the 7 quarter horizon changes from 2.25 to 2.24 (s.e.=0.68), and the coefficient for nontradable payroll changes from 2.83 to 2.58 (s.e.=0.81).

[7] Formally, denote by $S^*_{a,t-1}$ the true $t-1$ wealth level using the county-specific price-dividend ratio and by $R^*_{a,t-1,t}$ the true return using the county-specific portfolio. Assume $S^*_{a,t-1}R^*_{a,t-1,t} = S_{a,t-1}R_{t-1,t} + e_{a,t-1,t}$, where $e_{a,t-1,t}$ is a county-specific component of the wealth change due to idiosyncratic heterogeneity and therefore is uncorrelated with $S_{a,t-1}R_{t-1,t}$, $Cov\left(S_{a,t-1}R_{t-1,t}, e_{a,t-1,t}\right) = 0$. Then if the true structural model is $\Delta_{a,t-1,t+h}y = \beta_h[S^*_{a,t-1}R^*_{a,t-1,t}] + \Gamma'_h X_{a,t-1} + \epsilon_{a,t-1,t+h}$, a regression of $\Delta_{a,t-1,t+h}y$ on $S_{a,t-1}R_{t-1,t}$ (and controls) will consistently estimate β_h. Alternatively, one can think of $S_{a,t-1}R_{t-1,t}$ as the excluded instrument and $S^*_{a,t-1}R^*_{a,t-1,t}$ as the endogenous variable in an instrumental variables design. Under the assumption of purely idiosyncratic heterogeneity, the first stage regression of $S^*_{a,t-1}R^*_{a,t-1,t}$ on $S_{a,t-1}R_{t-1,t}$ would yield a coefficient of 1, in which case the IV coefficient coincides with the reduced form coefficient we estimate.

Figure B.1: Household Stock Market Wealth in the FAUS



Notes: The figure reports household equity wealth as reported in the Financial Accounts of the United States table B.101.e line 7. Retirement accounts include equities held through life insurance companies (line 10) and in defined contribution accounts of private pension funds (line 11), federal government retirement funds (line 12), and state and local government retirement funds (line 13).

changes, leading us to over-estimate or under-estimate the consumption wealth effects. Importantly, while previous work has documented that wealthy households have portfolios tilted toward riskier asset classes than the general population (Carroll, 2000; Calvet and Sodini, 2014), here what matters is risk-taking *within* stock portfolios.

Retirement wealth. A second measurement issue pertains to stock market wealth held in retirement accounts. Even if households in different counties hold the same portfolio, they may vary in their holdings of stocks in retirement accounts, which do not generate taxable dividend income and therefore do not appear in the SOI data. We begin by plotting in Figure B.1 the distribution of household holdings of corporate equity between non-retirement (directly held and mutual funds) and retirement accounts using data from the Financial Accounts of the United States. Throughout our sample period, the majority of equity is directly held and less than 20% is held in retirement accounts.[8]

We next use data from the Survey of Consumer Finances to examine the relationship between total stock-market wealth and non-retirement stock-market wealth in the cross-section of U.S. households. We pool all waves from 1992 to 2013, consistent with the sample period for our benchmark analysis. We create two definitions of stock-market wealth (both total and retirement) – one based on a narrow definition of stock funds and a second broader definition. For the first definition we include funds (individual retirement accounts, employer-sponsored pension plans, mutual funds, trusts and managed investment accounts) that are fully invested in stocks. For the second definition we

[8]Retirement accounts here include only defined contribution accounts and exclude equity holdings of defined benefit plans. This definition accords with our empirical analysis since fluctuations in the market value of assets of defined benefit plans do not directly affect the future pension income of plan participants.

Table B.1: Summary Statistics (values are in 1992 dollars).

Variable	Mean	Std. Dev.	Min	Max
total stock wealth	45,642	514,777	0	4.69×10^8
non-retirement stock wealth	31,109	472,259	0	4.69×10^8
total stock wealth (broad)	56,040	572,393	0	5.57×10^8
non-retirement stock wealth (broad)	32,564	483,605	0	5.54×10^8

include funds that are diversified between stocks and bonds or other financial assets or (from 2004 onward) have at least 50% of their value invested in stocks. We define non-retirement stock-market wealth as the stock-market wealth from direct holdings of stocks and from mutual funds, while total stock-market wealth sums the wealth from direct holdings of stocks and all stock funds. Finally, we deflate all nominal values using the CPI to convert to 1992 dollars. Table B.1 reports summary statistics for the stock-market wealth variables based on the narrow and broader definition of stock funds, respectively. The average values of total and non-retirement stock-market wealth are fairly similar with a difference of around \$15,000 in the first case and \$25,000 in the second case.

Table B.2 reports the coefficients from regressions of total stock market wealth on non-retirement wealth. Columns (1) and (2) use the narrow definition of stock market wealth and columns (3) and (4) the broad definition. There is a positive constant term in columns (1) and (3), indicating that retirement stock market wealth is more evenly distributed than non-retirement wealth. Moreover, the coefficients on non-retirement wealth are between 1.05 and 1.08 and the R^2s are between 0.83 (broad) and 0.94 (narrow). Therefore, total stock-market wealth and non-retirement stock market wealth vary almost one-for-one. The relationship changes little in columns (2) and (4) which include controls for demographics (age, college degree) and year fixed effects. Thus, disregarding heterogeneity in retirement stock market wealth is unlikely to impact our estimation results substantially.

Non-public companies. A third source of measurement error arises because dividend income reported on form 1040 includes dividends paid by private C-corporations. Such income accrues to owners of closely-held corporations and is highly concentrated at the top of the wealth distribution. Figure B.2 uses data from the Financial Accounts of the United States to plot the market value of equity issued by privately held C-corporations as a share of total equity issued by domestic C-corporations.[9] This share never exceeds 7% of total equity, indicating that as a practical matter dividend income from non-public C-corporations is small. Moreover, as described in Appendix B.1 our baseline sample excludes a small number of counties with a substantial share of dividend income

[9] Since 2015, table L.223 of the Financial Accounts of the United States has reported equity issued by domestic corporations separately by whether the corporation's equity is publicly traded, with the series extended back to 1996 using historical data. While obtaining market values of privately held corporations necessarily requires some imputations (Ogden et al., 2016), we believe the results to be the best estimate of this split available and unlikely to be too far off.

Table B.2: Total stock wealth and non-retirement stock wealth.

	Narrow definition		Broad definition	
	(1)	(2)	(3)	(4)
non-pension	1.056**	1.053**	1.080**	1.077**
stock wealth	(0.00893)	(0.00893)	(0.0122)	(0.0122)
age		2019.5**		2848.4**
		(93.89)		(1.690)
age^2		-16.79**		-21.61**
		(0.887)		(1.690)
college		22874.4**		37017.9**
degree		(1089.7)		(1567.7)
Constant	12803.0**		20854.3**	
	(423.3)		(616.0)	
Year FE	No	Yes	No	Yes
unique observations	36,688	36,682	36,688	36,682
adj. R^2	0.938	0.939	0.833	0.835

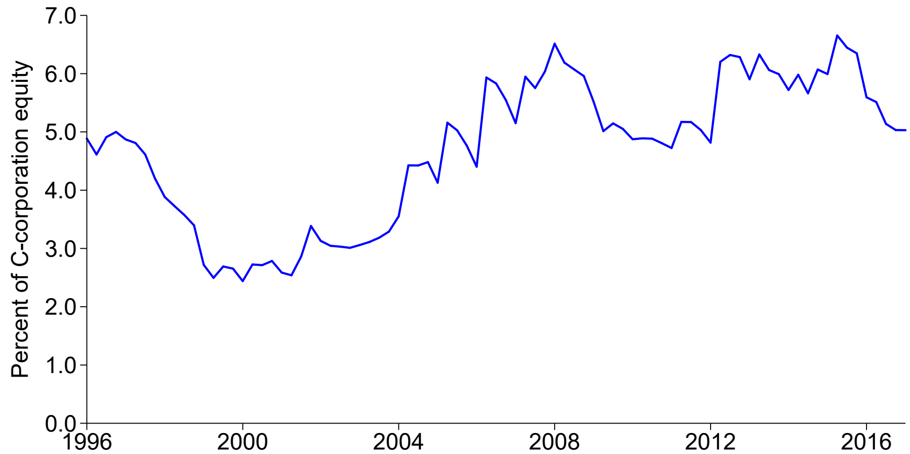
Notes. Standard errors in parentheses. In columns (1) and (2), total stock wealth is defined as the sum of the value of directly held stocks as well as the value of IRA accounts, mutual funds, trusts, annuities and managed investment funds, and employer-sponsored pension funds that are primarily invested in stocks and non-retirement stock wealth is defined as the sum of the value of directly held stocks and mutual funds that are primarily invested in stocks. In columns (3) and (4), total stock wealth is defined as the sum of the value of directly held stocks as well as the value of IRA accounts, mutual funds, trusts, annuities and managed investment funds, and employer-sponsored pension funds that are primarily invested in stocks or are diversified between stocks and other financial assets (with at least 50% invested in stocks from 2004 onwards) and non-retirement stock wealth is defined as the sum of the value of directly held stocks and mutual funds that are primarily invested in stocks or are diversified between stocks and other financial assets (with at least 50% invested in stocks from 2004 onward). All dollar values are in 1992 dollars. All regressions are weighted using the SCF sampling weights. ** denotes significance at 1%, * denotes significance at 5%.

reported by late filers who disproportionately own closely-held corporations, and Table 3 reports a specification which excludes counties containing the headquarters of a private corporation on the Forbes list of the largest private companies. Therefore, non-public C-corporation wealth does not appear to meaningfully affect our results.

B.3 Summary Statistics

Table B.3 reports the mean and standard deviation of the 8 quarter change in the labor market variables. It also reports the standard deviation after removing county-specific means and state-quarter means, with the latter being the variation used in the main analysis.

Figure B.2: Equity of Privately Held C-Corporations



Notes: The figure reports the market value of equity of privately held C-corporations as a share of total (privately held plus publicly-traded) equity of domestic C-corporations as reported in the Financial Accounts of the United States table L.223 lines 29 and 32.

Table B.3: Summary Statistics

Variable	Source	Mean	SD	Within county SD	Within county and state-quarter SD	Obs.
Quarterly total return on S&P 500	Shiller	0.019	0.072			108
Capitalized dividends/labor income	IRS SOI	1.558	1.252	0.592	0.355	314 912
Log empl., 8Q change	QCEW	0.024	0.054	0.048	0.033	316 751
Log payroll, 8Q change	QCEW	0.085	0.077	0.072	0.049	316 751
Log nontradable empl., 8Q change	QCEW	0.030	0.071	0.065	0.056	309 296
Log nontradable payroll, 8Q change	QCEW	0.080	0.090	0.085	0.066	309 296
Log tradable empl., 8Q change	QCEW	−0.021	0.130	0.123	0.106	294 728
Log tradable payroll, 8Q change	QCEW	0.044	0.159	0.152	0.130	294 728

Notes: The table reports summary statistics. Within county standard deviation refers to the standard deviation after removing county-specific means. Within county and state-quarter standard deviation refers to the standard deviation after partialling out county and state-quarter fixed effects. All statistics weighted by 2010 population.

B.4 County demographic characteristics and stock wealth

To more clearly illustrate that our empirical strategy does not depend on stock wealth to labor income being randomly assigned across counties, we correlate the (time-averaged) county level value of stock wealth to labor income with a number of county level demographics. Specifically, we use time-averaged data from the 1990, 2000 and 2010 US Census to compute the county level

Table B.4: County demographics regressions

	(1)	(2)	(3)	(4)	(5)	(6)
Bachelor degree or higher (%)	0.05^{**}					0.08^{**}
	(0.01)					(0.01)
Median age		0.08^{*}				-0.03
		(0.04)				(0.02)
Retired (%)			0.10^{*}			0.26^{**}
			(0.04)			(0.03)
Female (%)				0.16^{**}		-0.06^{*}
				(0.03)		(0.03)
White (%)					-0.00	-0.02^{**}
					(0.00)	(0.00)
Population weighted	Yes	Yes	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.29	0.19	0.20	0.17	0.15	0.49
Observations	3,141	3,141	3,141	3,141	3,141	3,141

Notes: The table reports coefficients and standard errors from regressing time-averaged capitalized dividends/labor income on county demographics. Standard errors in parentheses are clustered by state. * denotes significance at the 5% level, and ** denotes significance at the 1% level.

shares of individuals 25 years and older with bachelor degree or higher, median age of the resident population, share of retired workers receiving social security benefits, share of females, and share of the resident population identifying themselves as white.[10] Table B.4 reports the coefficient estimates from population weighted regressions of stock wealth to labor income on each demographic characteristics as well as a regression including all demographic characteristics (last column). All regressions include state fixed effects. Unsurprisingly, the share of retired workers and share with college degree are robustly positively related with the average stock wealth to labor income ratio in a county. The share of females and white is negatively related with stock wealth to labor income although the effects are smaller. Median age does not co-move with stock wealth to income after controlling for the other demographic characteristics.

B.5 Total stock wealth imputation

We use the relation in the Survey of Consumer Finances between total stock wealth, non-retirement stock wealth, and household head demographic characteristics to impute total stock wealth in a county. We measure total stock wealth as the self-reported value of directly held stocks, as well as the value of retirement accounts, employer-sponsored pension plans, mutual funds, and trusts,

[10]For the college share we use the American Community Survey rather than the 2010 US Census.

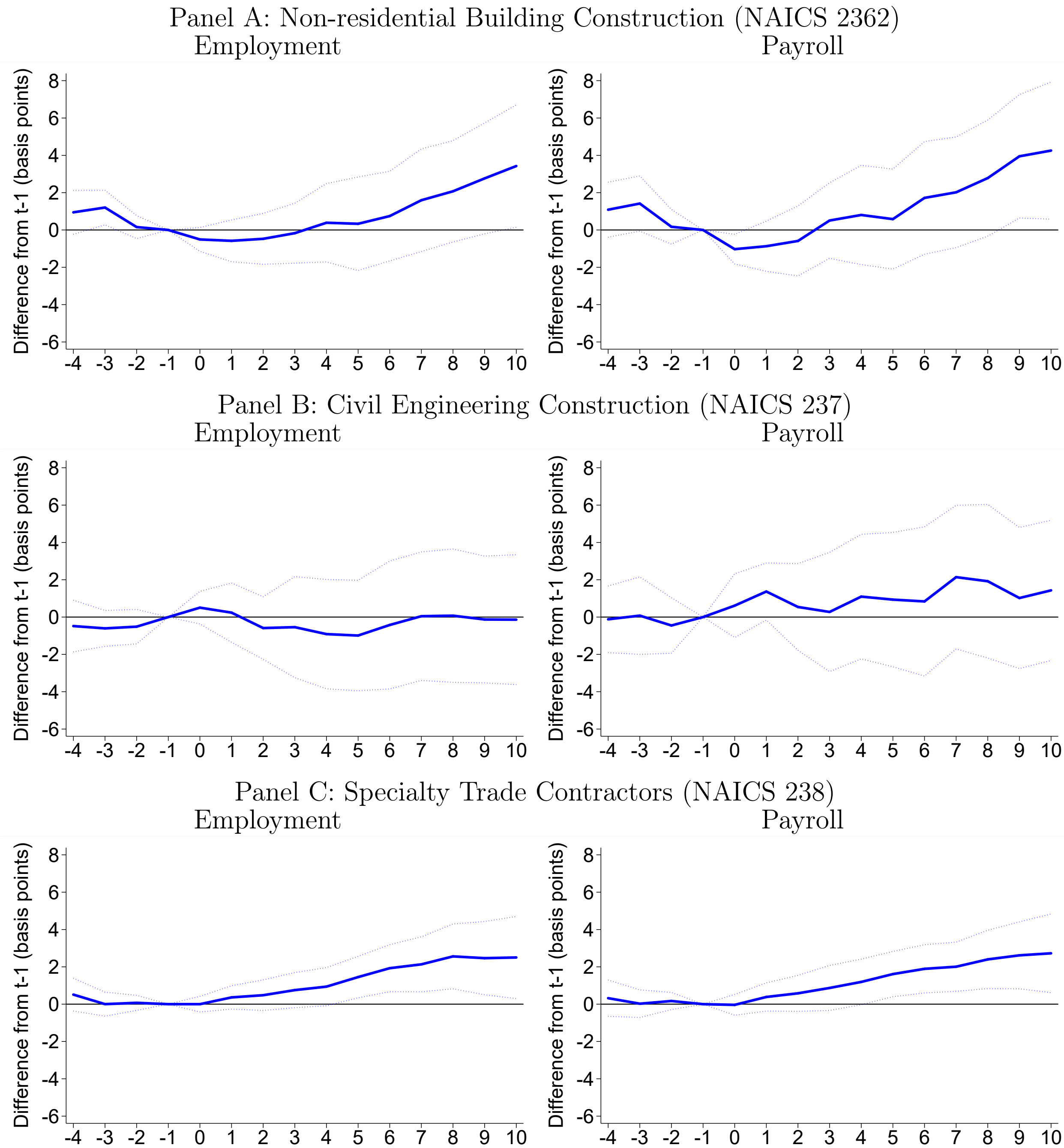
and managed investment accounts that are fully invested in stocks. Non-retirement stock wealth is similarly defined as the self-reported value of directly held stocks and mutual funds that are fully invested in stocks.[11]

We pool all waves from 1992 to 2013 of the SCF, so we also deflate the values of total stock wealth and non-retirement stock wealth using the CPI. We then regress total stock wealth on non-retirement stock wealth, a number of age bins (below 25, 25-34, 35-44, 45-54, 55-64, 65 and over), and an indicator for whether the household head has a college degree. We then use these coefficient estimates, together with the capitalized dividend income (deflated by the CPI) and the relevant county-level demographic information on population shares in different age bins and the college share (interpolated at yearly frequency from the decadal census and also extrapolated past 2010) to construct the imputed real total stock wealth for each county and year. Finally, we reflate this value back using the CPI to get a nominal value, similar to the nominal values we use in the rest of the analysis.

B.6 Construction Sub-components

[11] We also construct total stock wealth imputations based on a broader definition of stock wealth, which includes funds that are diversified between stocks and bonds or other financial assets or (from 2004 onward) have at least 50% of their value invested in stocks. These results are available on request.

Figure B.3: Non-residential Construction Results



Notes: The figure reports the coefficients β_h from estimating Eq. (15) for total quarterly employment (left panel) and wages (right panel) at each quarterly horizon h shown on the lower axis. The shock occurs in period 0 and is an increase in stock market wealth equivalent to 1% of annual labor income. The dashed lines show the 95% confidence interval bands based on standard errors two-way clustered by county and quarter.