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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.

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An online appendix is available at
http://www.nber.org/data-appendix/w25959

Dynamic link to the most recent draft: is available at
https://www.dropbox.com/s/7q1zzxkkr184rjy/crns_stock_wealth_effects.pdf?dl=0

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, $C_{a,t}^{T}$, and a nontradable good that must be consumed in the area where it is produced, $C_{a,t}^{N}$, 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:

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

Competitive firms produce the nontradable good $Y^N_{a,t}$ using labor $L^N_{a,t}$ and capital $K^N_{a,t}$ and the Cobb-Douglas technology:

$$Y^N_{a,t} = F\left(K^N_{a,t}, L^N_{a,t}\right) = \left(K^N_{a,t}/\alpha\right)^{\alpha} \left(L^N_{a,t}/\left(1-\alpha\right)\right)^{1-\alpha}.$$

There are two technologies for producing the tradable consumption good Y^T_t:

$$Y^T_t = \left(\int_a F\left(K^T_{a,t}, L^T_{a,t}\right)^{\frac{\varepsilon-1}{\varepsilon}} da\right)^{\frac{\varepsilon}{\varepsilon-1}} + G_t\left(\tilde{K}^T_t\right).$$

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

$$F\left(K^T_{a,t}, L^T_{a,t}\right) = \left(K^T_{a,t}/\alpha\right)^{\alpha} \left(L^T_{a,t}/\left(1-\alpha\right)\right)^{1-\alpha}.$$

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:

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

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 $l^N_{a,0}$ and $l^T_{a,0}$ similarly for the nontradable and tradable sectors. In Appendix A.4 we present closed-form solutions for $p_{a,0}, w_{a,0}, l_{a,0}, l^N_{a,0}, l^T_{a,0}$ 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):

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

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

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

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

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

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 $S_{a,0} \equiv \frac{x_{a,0}Q_0}{\overline{WL}_0}$ 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:

$$S_{a,0}R_0 = \frac{x_{a,0}\Delta Q_0}{\overline{WL}_0}. \tag{13}$$

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.

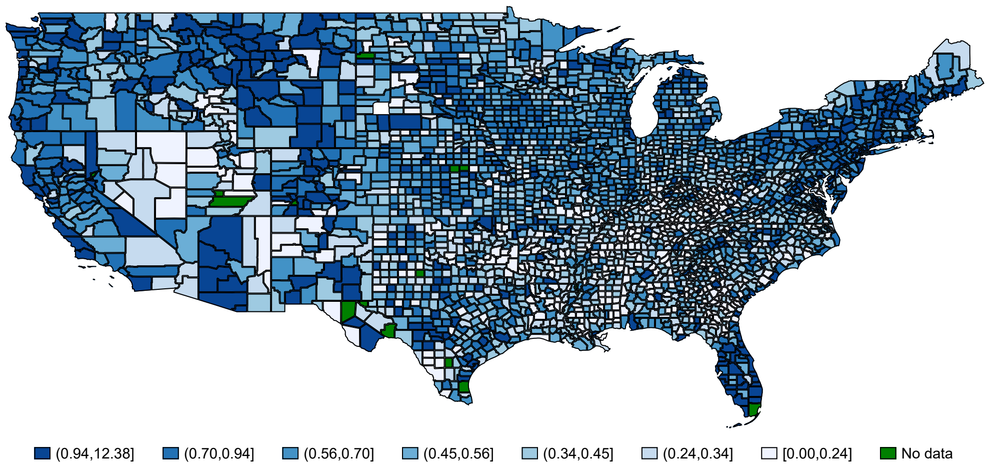
Stock market return. We equate the stock market return $R_{t-1,t}$ with the total return on the S&P500.[12] Figure 2a shows the serial correlation in quarterly returns during our sample period and Figure 2b the cumulative return following a one standard deviation increase in the stock market. As is well 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.

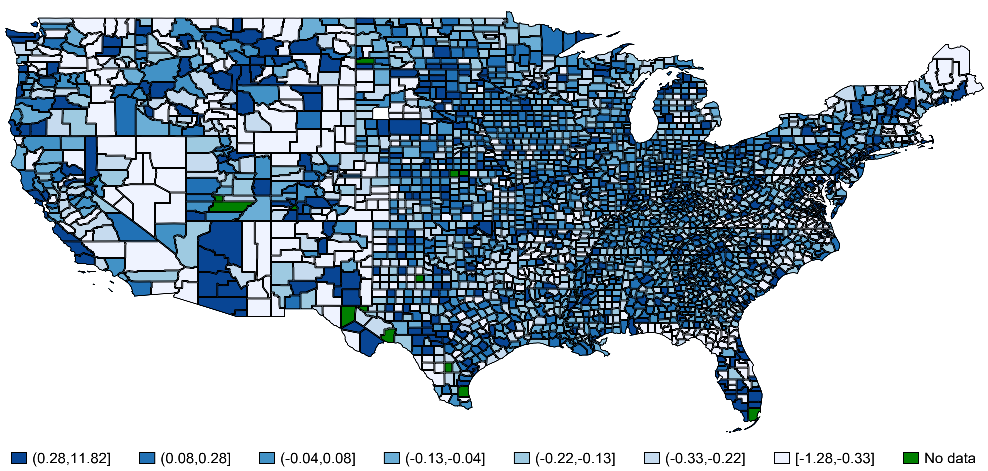
[12] We obtain the S&P500 total return and dividend-price ratio from Robert Shiller's website: http://www.econ.yale.edu/~shiller/data/ie_data.xls.

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

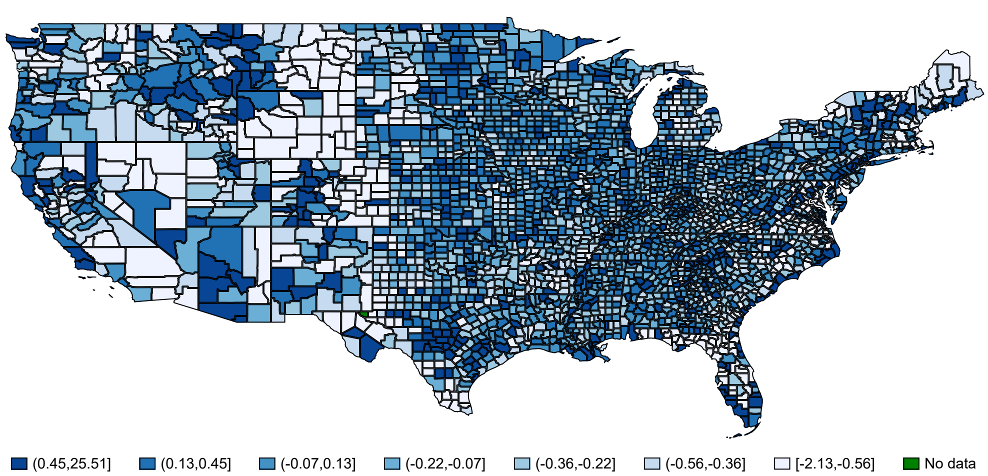
(a) 1990



(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.

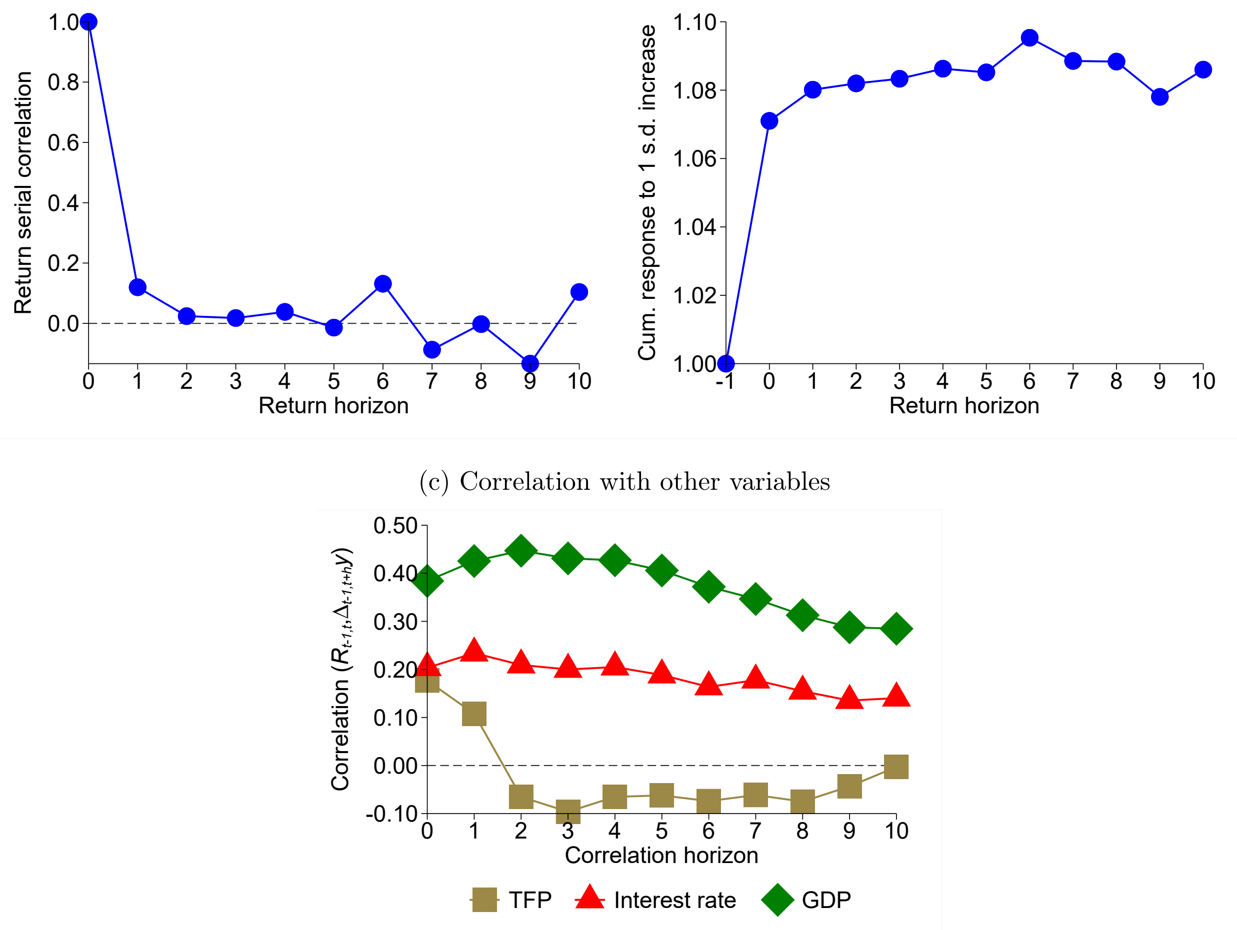
[14]The NAICS version of the QCEW contains a number of transcription errors prior to 2001. We follow Chodorow-Reich and Wieland (2018, Appendix F) and hand-correct these errors before applying the seasonal adjustment procedure.

[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

(a) Serial correlation of returns

(b) Cumulative return response



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 $\Pi_{h=0}^{j}\left(1+\beta_h\sigma_R\right)$ 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 $E\left[R_{t-1,t}\mu_t\right] = 0$ 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

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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

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

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.

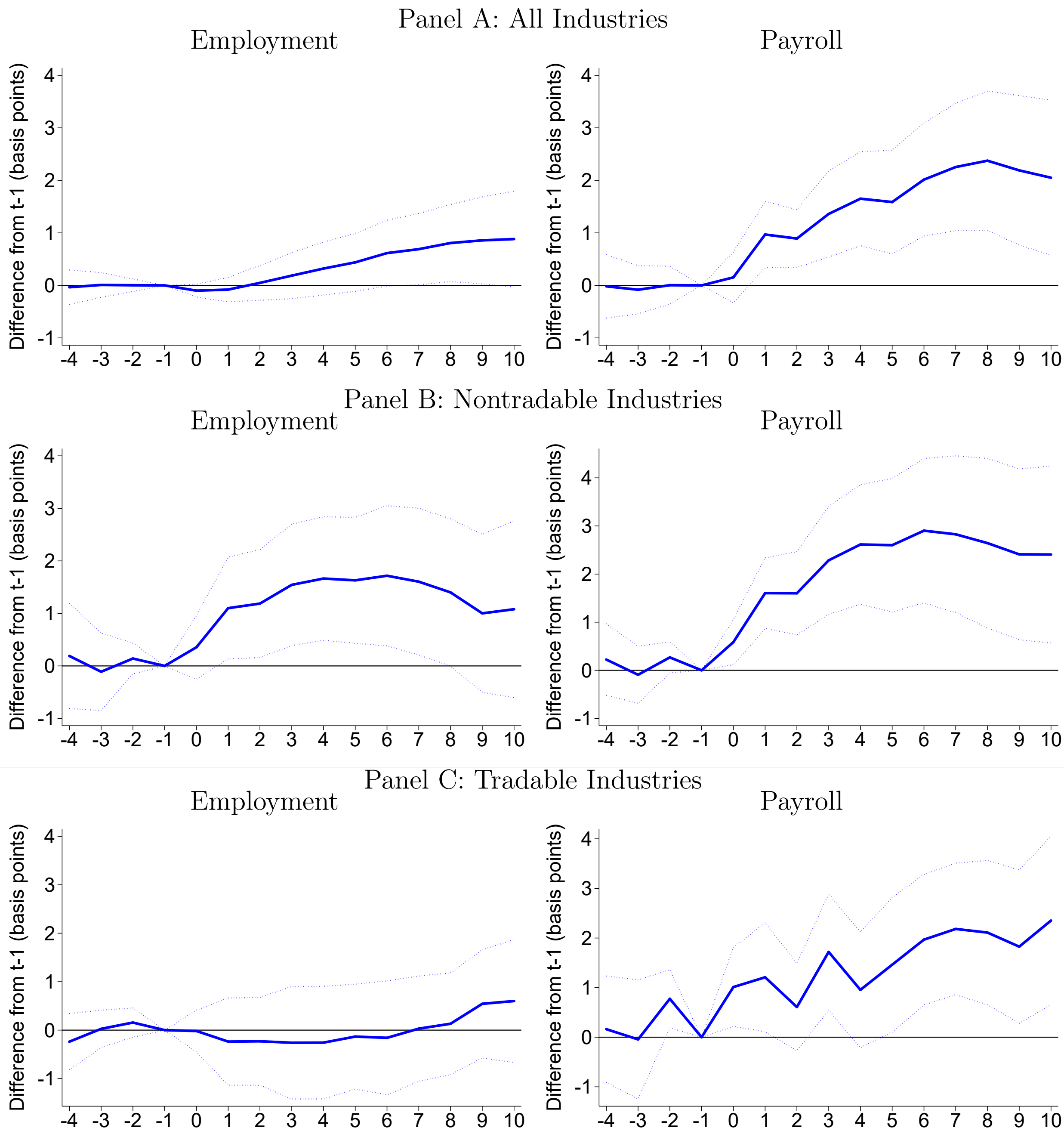
Figure 4 shows a large response of employment and payroll in the residential building construction sector (NAICS 2361). We show this sector separately because, while it also produces output consumed locally, the magnitude does not easily translate into our theoretical model since the sector produces 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.

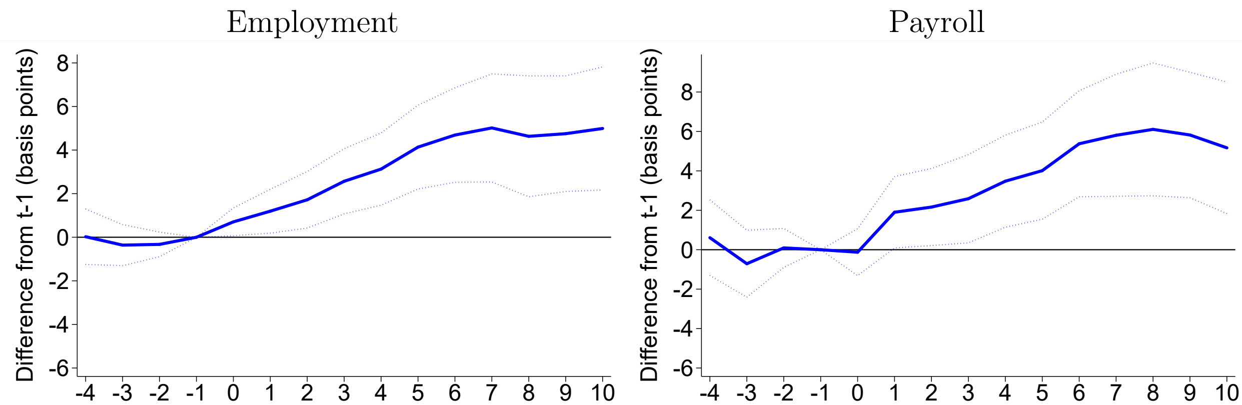
inflows do not explain the increase in local employment when stock market wealth rises.

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.

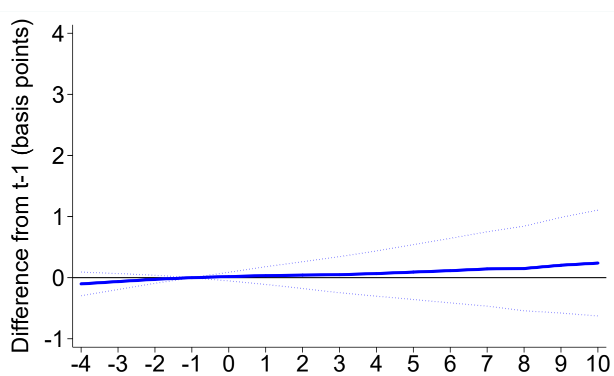
Table 2 shows robustness to subtracting or adding covariates to the baseline specification. Rows 2 and 3 expand the variation used to identify the response by removing the Bartik control and using quarter rather than state-by-quarter fixed effects. The results are similar to the baseline specification.

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:

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

where

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

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

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.

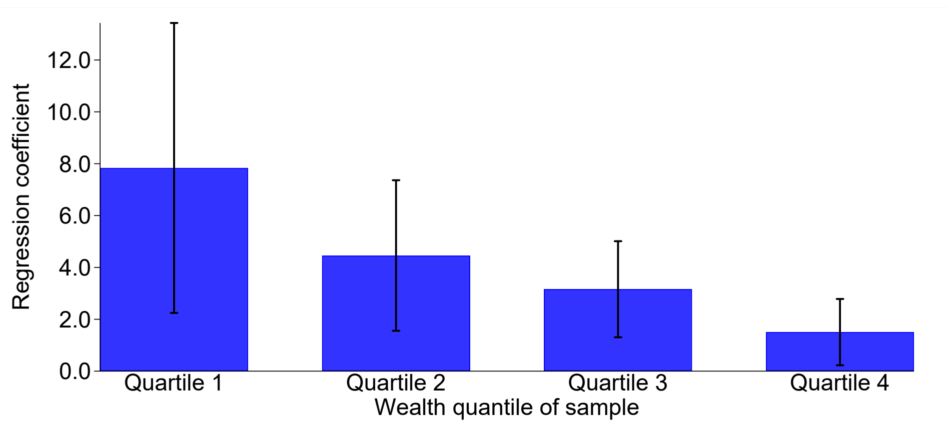
We start by taking a time average within each state of real (deflated by the price index for personal consumption expenditure) dividends per person and then sort states along this

[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:

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

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

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

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

Here, $l_0 = \log(L_0/\overline{L}_0)$ and $w_0 = \log(W_0/\overline{W})$ 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:

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

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.

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

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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