The Aggregate Labor Supply Curve at the Extensive Margin: A Reservation Wedge Approach*

Preston Mui† (UC Berkeley)
Benjamin Schoefer‡ (UC Berkeley)

October, 2019

Abstract

We present a theoretically robust and empirically tractable representation of the aggregate labor supply curve at the extensive (employment) margin. The core concept we define is the individual-level reservation (labor) wedge: the tax-like gap between an individual's potential earnings and her marginal rate of substitution. This micro wedge is a sufficient statistic that collapses rich multi-dimensional heterogeneity in, e.g., tastes for leisure, marginal utilities of consumption, hours constraints, and worker-specific wages. The CDF of the wedges *is* the aggregate labor supply curve at the extensive margin. We then directly measure the wedge distribution in a survey representative of the U.S. population – thereby mapping out the global empirical curve. For small deviations, the empirical curve exhibits locally large Frisch elasticities above 3 (consistent with business cycles evidence). Rather than constant, the empirical arc elasticities shrink towards 0.5 for larger, upward shifts (hence reconciling large local elasticities with the small elasticities suggested by recent quasi-experimental evidence). In a model meta-analysis, we find that no existing labor supply block matches the empirical curve. We engineer one (representative-agent) specification that precisely matches the empirical curve. The resulting labor supply block implies relatively smooth labor wedges over U.S. business cycles.

*We thank Chaoran Yu for excellent research assistance. For comments we thank Mark Bils, Gabriel Chodorow-Reich, Shigeru Fujita, Adam Guren, Greg Kaplan, Ellen McGrattan, Alisdair McKay, Luigi Pistaferri, Sergio Salgado (discussant) and Gianluca Violante, and seminar and conference participants at the NBER Dynamic Equilibrium Models meeting, the NBER Summer Institute 2019 (Micro Data and Macro Models), the Federal Reserve Bank of Philadelphia, Stanford University/SIEPR, the Federal Reserve Bank of San Francisco/West Coast Matching Workshop, and the Society of Economic Dynamics Annual Meeting. For financial support of the custom survey, we thank SIEPR at Stanford, the Clausen Center and the Institute for Research on Labor and Employment at UC Berkeley, and NORC at U Chicago.

†mui@berkeley.edu
‡schoefer@berkeley.edu

1 Introduction

The aggregate labor supply curve – the sum of individuals' desired labor supply as a function of wages – is a core feature of macroeconomic models. In market-clearing equilibrium models, it forms the iron link between wages and employment. In New Keynesian models with nominal frictions, it shapes the slope of the Phillips curve, the trade-off between the aggregate labor input and wage-inflation pressure. In models of wage bargaining or wage posting, the curve shapes workers' reservation wages. The slope of the curve also determines the potential welfare costs of employment adjustment and scales the cyclical amplitude of labor wedges.

Despite their theoretical centrality, labor supply blocks in macroeconomic models commonly rely on ad-hoc abstractions. For example, labor supply may vary through conventional intensive-margin hours choices, despite the fact that in the data, aggregate labor hours primarily adjust along the extensive, i.e. employment, margin. Alternatively, aggregate extensive margin labor supply models often appeal to a fictional utilitarian head of a large representative household with a pooled budget constraint. By contrast, more realistic atomistic labor supply models often either lack an extensive margin, or feature an overwhelming complexity of interrelated heterogeneity, precluding a tangible and simple-to-parameterize aggregate labor supply curve convenient for calibration and quantitative analysis.

We present a theoretically robust yet tractable framework characterizing the aggregate labor supply curve at the extensive margin, the first step of our paper. Before aggregation, we begin with an individual-level discrete employment choice, which we summarize in form of a micro *reservation (labor) wedge*: a tax-like gap $1 - \xi^*_{it}$ between the individual's idiosyncratic potential earnings and the idiosyncratic extensive-margin marginal rate of substitution. The wedge denotes the hypothetical mark-up or mark-down on the monetary benefit to working that would render individual i indifferent between employment and nonemployment. The wedge is a micro *sufficient statistic* for each worker's extensive-margin labor supply behavior, summarizing model-specific features and heterogeneity in, e.g., tastes for leisure or disutility from working, marginal utilities of consumption, hours constraints, potential wages, and distributional assumptions, a variety of parameterizations and equilibrium outcomes. While we focus on the Frischian perspective, the framework also accommodates uncompensated, or longer-run, settings with wealth effects, and variety of frictions and extensions such as intensive margin choices.

The cumulative distribution function of the micro wedges fully characterizes – in fact, *is* – the extensive-margin aggregate labor supply curve. As its argument, the curve takes a generalized aggregate wage concept: the *prevailing* aggregate wedge $1 - \Xi_t$, which captures factors such as aggregate productivity fluctuations, linear taxes, labor demand shocks, or labor market frictions. Shifts in this prevailing wedge sweep up *marginal workers* – those whose reservation wedges are around the original prevailing aggregate wedge and who hence drive extensive margin adjustment. The aggregate extensive-margin elasticity is determined by the density of marginal workers around the prevailing aggregate wedge.[1]

[1] At a broad methodological level, we express a given household's micro propensity to engage in a discrete choice as

Second, we measure the empirical reservation wedge distribution in a custom survey by directly asking respondents for their reservation wedge in a tailored question. It directly asks the respondent which percent size of a transitory increase or decrease in her potential earnings would render her indifferent between employment and nonemployment. Our approach is reminiscent of reservation wage surveys, but our reservation wedge question covers all labor force statuses, rather than just the unemployed, and appeals to a Frischian and neoclassical labor supply notion.[2]

The empirical wedge distribution exhibits a large mass around one – where the reservation wage is close to the individual's actual wage i.e. the location of marginal workers. This local mass of marginal workers implies a large *local* Frisch elasticity around 3. Still, the distribution is widely dispersed, implying that the typical worker is inframarginal in that she derives considerable worker surplus, consistent with models of heterogeneity in job quality (Mortensen and Pissarides, 1994; Bils, Chang, and Kim, 2012; Jäger, Schoefer, and Zweimüller, 2018) and present in lifecycle models Rogerson and Wallenius (2008) or with heterogeneous disutility of labor supply (Gali, 2015; Boppart and Krusell, 2016), but inconsistent with models of homogeneity (e.g. Hansen, 1985; Rogerson, 1988), as well as textbook DMP models without heterogeneity.

This high *local* Frisch elasticity matches the "macro calibrations" that are an order of magnitude above quasi-experimental estimates of realized employment adjustment to short-run net-wage changes Chetty et al. (2012).[3] However, we also find that the shape of the empirical curve implies arc elasticities that are far from constant – falling below 1.0 for large shifts – asymmetrically so particularly upwards.

Since business cycle fluctuations feature small changes in wages (or productivity), local labor supply elasticities are allocative, which our survey implies to be substantially higher than the arc elasticities from large wage changes. This non-constancy of the elasticity raises the possibility that very large shifts, such as tax holidays (Bianchi, Gudmundsson, and Zoega, 2001; Martinez, Saez, and Siegenthaler, 2018; Sigurdsson, 2018), may imply small Frisch arc elasticities – while perhaps still masking large local Frisch elasticities. This insight implies a trade-off between statistical power and overcoming adjustment costs (e.g., Chetty, 2012), and measuring the local elasticities relevant for smaller shocks away from the assumption of constancy of elasticities.

Third, we then compare the empirical supply curve to those implied by specific models with extensive margin labor, using the wedge as a bridge to illuminates otherwise opaque aggregate

continuous "gap" from the adjustment threshold, and then derive aggregate responsiveness in this adjustment from its cross-sectional distribution. Berger and Vavra (2015) study durable goods expenditure with fixed adjustment costs and derive the aggregate responsiveness to aggregate shocks. Related is also the role of the price gap distribution in sticky price models (e.g., Alvarez and Lippi, 2014). Our spot labor market plus flow participation costs (rather than one-time costs) eliminates dynamic complications compared to these contexts.

[2]Pistaferri (2003) measures intensive-margin intertemporal labor supply preferences in a household survey by comparing individual-level wage expectations with hours worked. Mas and Pallais (2019) obtain revealed preference estimates for intensive-margin hours labor supply curves.

[3]We hereby provide a new rationalization for large macro extensive-margin elasticity, complementing existing alternative discussions by (Keane and Rogerson, 2012, 2015), who argue that structural labor supply elasticities may be larger than implied by lifcycle hours-wage comovement in richer micro models of labor supply (and with whom we share a focus on elasticity implied by preferences), and Peterman (2016), who studies heterogeneous elasticities across demographic groups.

labor supply curves and their determinants. We find that no labor supply blocks of existing models comes close to matching the non-constant and asymmetric arc elasticities of the empirical curve. We start with representative, full-insurance households with ad-hoc MaCurdy (1981) labor supply (Gali, 2015) and fully indivisible labor (Hansen, 1985; Rogerson, 1988). We also integrate an intensive margin, studying the Rogerson and Wallenius (2008) lifecycle model with margins. We then introduce an extensive-margin choice into atomistic heterogeneous agent models with borrowing constraints (Bewley, 1986; Huggett, 1993; Aiyagari, 1994; Chang and Kim, 2006, 2007; Achdou, Han, Lasry, Lions, and Moll, 2017; Debortoli and Galí, 2017; Kaplan, Moll, and Violante, 2018).

Fourth, we reverse-engineer one model to *precisely* match the empirical curve: a representative household consisting of members heterogeneous in labor disutility. We fit and provide a ready-to-use parametric polynomial approximation of the labor disutility function implied by the empirical reservation wedges, a naturally increasing and convex function of the employment rate directly identified by the empirical wedges. (This method could generally match any given reservation wedge distribution.)

We assess the macroeconomic consequences of this data-consistent labor supply curve taken at face value, using as a performance measure the labor wedge (Chari, Kehoe, and McGrattan, 2007; Shimer, 2009), the gap between the aggregate MPL and MRS time series. The resulting labor market approximately acts as a high-elasticity model in that local region of small cyclical employment deviations, exhibiting a much less volatile labor wedge (and hence appears closer to market clearing) particularly during recessions.

The reservation wedges trace out *desired* spot-market labor supply, i.e. underlying preferences over employment and nonemployment. Our focus thereby contrasts with empirical investigations of the *realized* employment effects of e.g. tax changes (e.g. Bianchi, Gudmundsson, and Zoega, 2001; Chetty, Guren, Manoli, and Weber, 2012; Martinez, Saez, and Siegenthaler, 2018; Sigurdsson, 2018), which in the presence of frictions need not perfectly reveal preferences but also reflect frictions, thereby providing calibration targets for the entire labor market structures. We aim to measure the deeper structural parameters guiding labor supply preferences prior to market structure.[4] Indeed, we find that in the micro data, realized employment outcomes are only imperfectly correlated with reservation wedges. This gap suggests either rationed labor supply due to frictions, measurement error or imperfect persistence in the wedges. Here, we use the panel dimensions of our custom US survey, and additionally draw on large German household surveys linked to administrative social security data. We also study the empirical micro covariates of the wedges, in our custom survey as well as related proxies we construct in existing surveys of the unemployed.

Similarly, by studying desired spot-market labor supply, i.e. underlying preferences, the reservation wedge framework is decidedly agnostic and prior to potential real-world frictions such as search or wage rigidities, which may detach desired from actual employment allocations – hence

[4] Moreover, for many policy questions, the realized employment effects net of frictions may be a useful input, such as for fiscal externalities (for UI applications, see, e.g., Chetty, 2006).

providing merely one new input into the long-standing question in labor and macroeconomics on the degree to which empirical employment adjustment actually occurs along households' desired labor supply curve (see, e.g., Lucas and Rapping, 1969; Hall, 1980, 2009; Schmitt-Grohé and Uribe, 2016; Krusell, Mukoyama, Rogerson, and Sahin, 2017; Mui and Schoefer, 2018; Jäger, Schoefer, and Zweimüller, 2018).[5]

Our paper shares one key intermediate step with an important set of existing research on aggregate labor supply (Chang and Kim, 2006, 2007; Gourio and Noual, 2009; Park, 2017), by explicitly modeling employment adjustment as driven by marginal workers defined within a distribution of reservation *wages*. These papers each present one specific model with heterogeneity and then estimate it relying on model-specific parametric and distributional assumptions.[6] By contrast, we provide a nonparametric and model-independent sufficient statistic in form of the reservation wedge, then apply this unifying framework to a existing specific models, and finally directly measure this concept in survey data. Our appraoch therefore along similar lines differs from structural estimations of specific parametric micro labor supply models with participation margins (e.g., Heckman and MaCurdy, 1980; Blundell, Pistaferri, and Saporta-Eksten, 2016; Attanasio, Levell, Low, and Sánchez-Marcos, 2018; Beffy, Blundell, Bozio, Laroque, and To, 2018).

In Section 2, we define the reservation wedge framework. In Section 3 we construct the empirical counterparts. In Section 4, we compare various models' distributions with the empirical one. In Section 5, we calibrate one model to precisely match the empirical curve, and study macro implications in a labor wedge analysis.

2 Framework: Micro Reservation Wedges and Aggregate Labor Supply

We microfound the extensive-margin aggregate labor supply curve from individual-level discrete choices between employment and nonemployment. We summarize these employment preferences by formalizing a sufficient statistic we call the individual *reservation labor wedge*, defined as the hypothetical level of a prevailing labor wedge (an aggregate shifter in the benefit to working such as a linear labor tax) that would render a given individual indifferent between employment and nonemployment. This scalar subsumes arbitrarily multi-dimensional heterogeneity, both ex-ante and ex-post, at the individual level. The aggregate labor supply curve is the CDF of the reservation wedge, tracing out the fraction of individuals desiring to work, as a function of the

[5]Relatedly, an interesting and important question beyond the scope of our paper is the treatment of the unemployed from the perspective of labor supply, in which they have wedges below one (i.e. they would like to work yet perhaps due to search frictions have yet to obtain an employment opportunity). Hence, their desired labor supply classifies them as similar to the employed rather than the out of the labor force (in contrast to the debate on the subcategories of the nonemployed e.g. as in Flinn and Heckman, 1983). Krusell, Mukoyama, Rogerson, and Sahin (2017) and Cairo, Fujita, and Morales-Jimenez (2019) present models with three labor force statuses and notions of labor supply in settings of heterogeneous agents a representative household respectively. Hall (2009) presents a DMP matching model with a representative household featuring unemployment, with standard labor supply along the intensive (hours per worker) margin.

[6]For example, Park (2017) assumes homogeneous labor supply disutility, and uses measured consumption, realized employment allocations combined with imputed wages and distributional assumptions to back out reservation wages. Gourio and Noual (2009) consider an empirical setting specified to normal distributions and derives estimating equations based on a social planner's large-household allocation.

prevailing wedge.

2.1 The Aggregate Labor Income Shifter

The aggregate labor supply curve traces out the response of aggregate employment to a concept we define as the *prevailing aggregate labor wedge* $1-\Xi_t$. It is a homogeneous and proportional labor-income shifter, to accommodate wage heterogeneity, and to capture aggregate wage fluctuations, changes in labor demand, or changes in labor taxes. This concept operationalizes the question: how much would aggregate labor supply change if all wages shifted by an amount given by wedge $1-\Xi_t$?

2.2 Micro Labor Supply

We now derive the individual-level reservation wedge for a benchmark spot labor market model.

Household's Problem Consider an individual i (where index $i \in [0,1]$) with time-separable utility $u_i(c_i, h_i)$ from consumption c_i and hours worked h_i, with budget Lagrange multiplier λ_{it}:

$$\max_{a_{it}, h_{it}, c_{it}} \mathbb{E}_t \sum_t \beta^t u_i(h_{it}, c_{it}) \tag{1}$$

$$\text{s.t. } a_{it} + c_{it} \leq a_{i,t-1}(1+r_{t-1}) + (1-\Xi_t) y_{it}(h_{it}) + T_{it}(.) \tag{2}$$

For now labor is indivisible, such that $h_{it} \in \{0, \widetilde{h}_{it}\}$; we permit intensive-margin hours choices below. Her potential earnings are $y_{it} = w_{it}\widetilde{h}_{it}$, at labor disutility $v_{it} = u_i(c_{it}^{e=1,\lambda_{it}}, \widetilde{h}) - u_i(c_{it}^{e=0,\lambda_{it}}, 0)$ (where hence consumption is respectively optimized against a constant λ, as we shall see below for the Frischian experiments and thereby also accommodating nonseparable preferences). Besides standard hours disutility, v_{it} may also include fixed participation costs (Cogan, 1981). We will put concrete structures on these terms below and when reviewing particular models in Section 4. $T_{it}(.)$ denotes other taxes and transfers (unrelated to labor income and employment status). Crucially, labor income is shifted by the prevailing labor wedge $1-\Xi_t$, which is not individual-specific and hence links individual-level preferences to aggregate labor supply.

Each individual i has preferred hours $h_{it}^* \in \{\widetilde{h}_{it}, 0\}$ according to a cutoff rule:

$$h_{it}^* = \begin{cases} 0 & \text{if } \; (1-\Xi_t) w_{it}\widetilde{h}_{it}\lambda_{it} < v_{it} \\ \widetilde{h}_{it} & \text{if } \; (1-\Xi_t) w_{it}\widetilde{h}_{it}\lambda_{it} \geq v_{it} \end{cases} \tag{3}$$

Equivalently, due to labor indivisibility, desired extensive-margin individual labor supply (employment) $e_{it} \in \{0,1\}$ is given by:

$$\Rightarrow e_{it}^* = \begin{cases} 0 & \text{if } \; (1-\Xi_t) y_{it}\lambda_{it} < v_{it} \\ 1 & \text{if } \; (1-\Xi_t) y_{it}\lambda_{it} \geq v_{it} \end{cases} \tag{4}$$

That is, an individual prefers employment if the utility benefits, $(1-\Xi_t) y_{it}\lambda_{it}$, outweigh the utility cost, v_{it} (such the net-of-wedge earnings exceed the extensive-margin MRS). For marginal – i.e. indifferent – individuals, the condition holds with equality.

Micro Reservation (Labor) Wedges We summarize an individual's extensive-margin labor supply preferences by defining as a micro sufficient statistic their idiosyncratic *reservation wedge* $1-\xi^*_{it}$: the *hypothetical* prevailing labor wedge $1-\Xi_t$ that would, if prevailing transitorily, render them *marginal* in a Frischian (λ-constant) setting:

$$1-\xi^*_{it} \equiv \frac{v_{it}}{y_{it}\lambda_{it}} \tag{5}$$

We write the micro reservation wedge as a lower case letter to differentiate it from the aggregate prevailing wedge. The *-symbol denotes the indifference condition rather than a potential idioscyncratically prevailing rather than reservation wedge for the given individual. It is the extensive-margin, discrete-choice analogue of the standard marginal rate of substitution at the intensive margin between labor disutility and consumption, divided by the wage/potential earnings concept. At the intensive margin with a continuous choice variable, this ratio is optimized to equal one. With an extensive margin (which arises due to nonconvexities such as fixed costs, or assumptions of indivisible labor etc.), workers face a wedge, which is potentially heteorgeneous and reflects workers' surplus from employment.

2.3 Aggregation

The Aggregate Labor Supply Curve The distribution of reservation wedges in period t, given by CDF $F_t(1-\xi^*)$, in turn fully characterizes the aggregate short-run labor supply curve as a function of transitory shifts in $1-\Xi_t$ (hence Frischian, λ-constant variation). The aggregate desired employment rate E_t equals the fraction of workers with $1-\xi^*_{it} \leq 1-\Xi_t$, i.e. the mass of employed households (defined by index $i \in [0,1]$): up until the marginal worker:

$$E_t(1-\Xi_t) = \int e^*_{it} di = \int_{-\infty}^{\infty} \mathbb{1}\left(1-\xi^* \leq 1-\Xi_t\right) dF_t(1-\xi^*) \tag{6}$$

$$= F_t\left(1-\Xi_t\right) \tag{7}$$

The reservation wedge reduces arbitrarily multi-dimensional heterogeneity to three terms: potential labor market earnings, budget multipliers, and labor disutility. These three components capture rich model-specific sources of heterogeneity, such as lifetime wealth, borrowing constraints, skills, hours requirements, job amenities, time endowments, or tastes for leisure. The wedge is a sufficient stastic for extensive-margin labor supply in that any two given specific models will feature isomorphic labor supply curves if and only if they generate same reservation wedge distribution $F(.)$.

Desired employment *adjustment*, e.g. to an increase in aggregate wedge from $(1-\Xi_t)$ to $(1-\Xi'_t)$, is driven by the mass of nearly-marginal workers, $F_t(1-\Xi'_t)-F_t(1-\Xi_t)$: those nonemployed in regime $1-\Xi_t$ but employed under $1-\Xi'_t > 1-\Xi_t$, i.e. with reservation wedges $1-\Xi_t < 1-\xi^*_{it} \leq 1-\Xi'_t$.

2.4 The Aggregate Extensive-Margin Frisch Elasticity

Definition In the reservation wedge framework, the extensive-margin Frisch labor supply elasticity emerges as one local property. For discrete wedge changes, the arc elasticity is:

$$\epsilon_{E_t,(1-\Xi_t)\to(1-\Xi_t')} = \frac{F_t\left(1-\Xi_t'\right) - F_t\left(1-\Xi_t\right)}{F_t\left(1-\Xi_t\right)} \Bigg/ \frac{(1-\Xi_t') - (1-\Xi_t)}{1-\Xi_t} \tag{8}$$

For infinitesimal changes in $(1-\Xi_t)$, the elasticity is:

$$\epsilon_{E_t,1-\Xi_t} = \frac{(1-\Xi_t)}{E_t}\frac{\partial E_t}{\partial(1-\Xi_t)} = \frac{(1-\Xi_t)f_t(1-\Xi_t)}{F_t(1-\Xi_t)} \tag{9}$$

For a preexisting wedge normalized to $1-\Xi_t = 1$, the elasticity is the reverse hazard rate (or inverse Mills ratio) at threshold 1, i.e. $f_t(1)/F_t(1)$ (any tax system can be subsumed as net wages w_{it} without loss of generality).

Constant Elasticity The framework clarifies the general conditions on the wedge distributions for a *constant* extensive-margin Frisch elasticity, a property convenient for calibration often assumed in ad-hoc specifications (two examples are in our model meta-analysis in Section 4). A power-law-like distributed wedge exhibits this property. Suppose $1-\xi^*$ follows a distribution $G_{1-\xi^*}$ with shape parameter $\alpha_{1-\xi^*}$ and maximum $(1-\xi^*)_{\max}$:

$$G_{1-\xi^*}(1-\xi^*) = \left(\frac{1-\xi^*}{(1-\xi^*)_{\max}}\right)^{\alpha_{1-\xi^*}} \tag{10}$$

The elasticity is equal to $\alpha_{1-\xi^*}$:[7]

$$\epsilon_{E_t,1-\Xi_t} = \frac{(1-\Xi_t)\frac{\alpha(1-\Xi_t)^{\alpha_{1-\xi^*}-1}}{(1-\xi^*)_{\max}^{\alpha_{1-\xi^*}}}}{\frac{(1-\Xi_t)^{\alpha_{1-\xi^*}}}{(1-\xi^*)_{\max}^{\alpha_{1-\xi^*}}}} = \alpha_{1-\xi^*} \tag{12}$$

[7]Specifically, the distributional assumptions specify a standard power law distribution $F(X) = P(x < X) = a \cdot \left(\frac{x}{X_{\min}}\right)^{-\gamma+1}$ with shape parameter $\gamma > 0$. A comparison with our wedge-based power-law-like distribution (10) clarify that we require the *inverse* of our wedge to follow a power distribution:

$$G_{1-\xi^*}\left(1-\xi^*\right) = P\left(X < 1-\xi^*\right) = \left(\frac{1-\xi^*}{(1-\xi^*)_{\max}}\right)^{\alpha_{1-\xi^*}} \Leftrightarrow P\left(\frac{1}{1-\xi^*} < \frac{1}{X}\right) = \left(\frac{\frac{1}{1-\xi^*}}{\frac{1}{(1-\xi^*)_{\max}}}\right)^{-\alpha_{1-\xi^*}} \tag{11}$$

which is a power-law distribution of $\frac{1}{1-\xi^*}$ with minimum $\frac{1}{(1-\xi^*)_{\max}}$, and shape parameter $\gamma = \alpha_{1-\xi^*} + 1$.

Such a power-like wedge distribution can emerge as long as *any one* of wedge components $(v_{it}, 1/\lambda_{it}, 1/y_{it})$ is power-distributed conditional on the other two.[8]

2.5 Extensions Within the Spot Labor Market Benchmark

Intensive Margin Hours Choices and Job Menus Even with intensive margin hours choices, the reservation wedge continues to encode the extensive-margin labor supply curve. Rather than $h_{it} \in \{\widetilde{h}_{it}, 0\}$, labor supply is a choice j from a menu of jobs $J_{it} = \{(y_{it,j}, v_{it,j})\}_j$, each permitted to differ in its earnings, and disutility (or amenities) $(y_{it,j}, v_{it,j})$. This general setting nests heterogeneity in hours $\widetilde{h}^j_{it}$, e.g. in a sparse set of hours options (e.g. 0, 20, or 40), or nearly continuous hours choices. But the setting is more general, permitting a menu of general job attributes, nesting nonconvexities in payoff y or costs v.

Our solution proceeds in two steps. First in the "inner loop", for any given wedge $1 - \Xi_t$, we define the intensive-margin job choice – at which stage we therefore intentionally ignore the participation constraint i.e. the extensive-margin choice:

$$\max_{a_{it}, j_{it} \in J_{it}, c_{it}} \mathbb{E}_t \sum_t \beta^t u(j, c_{it}) \tag{15}$$

$$\text{s.t. } a_{it} + c_{it} \le a_{i,t-1}(1 + r_{t-1}) + (1 - \Xi_t) y_{it,j} + T_{it}(.) \tag{16}$$

where optimal job choice is defined as a discrete choice, maximizing utility. This "inner loop" gives the best job choice conditional on working (at all):

$$j^*(1 - \Xi_t) = \underset{j \in J_{it}}{\text{argmax}} \{(15) \text{ s.t. } (16) | 1 - \Xi_t\} \tag{17}$$

Second, in the "outer loop", extensive-margin labor supply is given by an augmented cutoff rule

[8] For example, let v_{it} follow a power distribution with maximum $v_{\max}$ and shape parameter α_v, independent from $g(y, \lambda)$, the joint distribution of y_{it} and λ_{it}. The distribution of $1 - \xi^*_{it}$ is then:

$$F_t(1 - \Xi_t) = P\left(1 - \xi^*_{it} \le 1 - \Xi_t\right) = P\left(v_{it} < (1 - \Xi_t) y_{it} \lambda_{it}\right) = \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} \min\left\{\left(\frac{(1 - \Xi_t) y \lambda}{v_{\max}}\right)^{\alpha_v}, 1\right\} g_t(y, \lambda) dy d\lambda \tag{13}$$

A powerful case is $\left(\frac{(1-\Xi_t) y_{it} \lambda_{it}}{v_{\max}}\right)^{\alpha_v} < 1$ for each (y, λ)-"type". Economically, this property implies positive nonemployment in each (y, λ)-type at $1 - \Xi_t$. Then the distribution becomes "cleanly" power-like:

$$\Rightarrow F_t(1 - \Xi_t) = \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} \left(\frac{(1 - \Xi_t) w \lambda}{v_{\max}}\right)^{\alpha_v} g_t(y, \lambda) dy d\lambda = \left(\frac{1 - \Xi_t}{v_{\max}}\right)^{\alpha} \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} (y\lambda)^{\alpha_v} g_t(y, \lambda) dy d\lambda \tag{14}$$

which itself is a power distribution with shape parameter α_v and maximum $1 - \xi^v_{\min} = \frac{v_{\max}}{\left[\int_{-\infty}^{\infty} \int_{-\infty}^{\infty} (y\lambda)^{\alpha} g_t(y, \lambda) dy d\lambda\right]^{1/\alpha_v}}$. That is, we have indexed the population by (y, λ). *Within* each (y, λ)-type, the reservation wedge is power-distributed since v_{it} is. So each (y, λ)-type exhibits a constant elasticity α_v. The aggregate elasticity – the weighted average of (y, λ)-types' elasticities α_v–is hence also α_v. By contrast, if Ξ_t or $\xi^v_{\min}$ is low enough for full employment in some types, these types' labor supply will be locally inelastic, so the aggregate elasticity will be smaller than α_v, at $\alpha_v \cdot P((1 - \Xi_t) y \lambda < v_{\max})$.

with the job choice respectively optimal at the given prevailing wedge $1 - \Xi_t$:

$$\Rightarrow e_{it}^* = \begin{cases} 0 & \text{if} \quad (1-\Xi_t) y_{it}^{j^*(1-\Xi_t)} \lambda_{it} < v_{it}^{j^*(1-\Xi_t)} \\ 1 & \text{if} \quad (1-\Xi_t) y_{it}^{j^*(1-\Xi_t)} \lambda_{it} \geq v_{it}^{j^*(1-\Xi_t)} \end{cases} \tag{18}$$

Here, the individual-level reservation wedge is an implicitly defined fixed point: it is the prevailing wedge that would render the individual indifferent between working and not working, *conditional on having (re-)optimized job choice*:

$$1 - \xi_{it}^* = \frac{v_{it}^{j^*(1-\xi_{it}^*)}}{y_{it}^{j^*(1-\xi_{it}^*)} \lambda_{it}} \tag{19}$$

These results also formally clarify that the job/hours choice under a prevailing wedge $1 - \Xi_t$ need not be the hours choice relevant to the reservation wedge, since job switching and hours reoptimization may occur towards the marginal job $j^*(1 - \xi_{it}^*)$.

Applying this framework to the intensive margin choice also illustrates why non-convexities in labor costs are often needed to generate extensive margin movements. Consider the specific case in which jobs differ by hours only, so potential earnings from working h_{it} hours is $y_{it} = h_{it} w_{it}$. With perfectly unrestricted hours choice and no nonconvexities, such as with standard MaCurdy (1981) utility specifications, we have ${h_{it}^*}^{1/\eta} = (1-\Xi_t)\lambda_{it} w_{it}$. Hence, the reservation wedge $1 - \xi_{it}^* = 1 - \Xi_t$ trivially tracks the prevailing wedge. That is, $h_{it}^{j^*(1-\xi_{it}^*)} = 0$, which intuitively holds as the first infinitesimal fraction of an hour yields no first-order disutility of work but a first-order consumption gain–precluding a meaningful extensive margin. A version of this consideration will emerge in the Rogerson and Wallenius (2008) model in our model meta-analysis in Section 4.

Non-Frischian, Uncompensated Variation The rest of the paper focuses on Frischian, short-run labor supply. However, our framework generalizes to non-Frischian contexts where λ need not remain constant. Examples are longer-lived shifts that entail wealth effects, and moreover due to d borrowing constraints or adjustment costs with illiquid assets.

Let $1 - \Xi_{t,t+\Delta}$ denote a wedge perturbation lasting for duration Δ (e.g. a discrete amount of periods, with $\Delta = 0$ denoting a one-period deviation). Special cases are the one-period (or in continuous time, instantaneous perfectly transitory) shift $1-\Xi_{t,t}$, and a permanent wedge $1-\Xi_{t,t+\infty}$. Consider settings in which at least for the time interval of the perturbation Δ, the other parameters are stable. $\lambda_{it}(1 - \Xi_{t,t+\Delta})$ denotes the budget multiplier, which in this non-Frischian context may be $(1 - \Xi_{t,t+\Delta})$-dependent. The decision rule for period-t employment then is:

$$e_{it}^* = \begin{cases} 0 & \text{if} \quad (1-\Xi_{t,t+\Delta}) y_{it} \lambda_{it}(1-\Xi_{t,t+\Delta}) < v_{it} \\ 1 & \text{if} \quad (1-\Xi_{t,t+\Delta}) y_{it} \lambda_{it}(1-\Xi_{t,t+\Delta}) \geq v_{it} \end{cases} \tag{20}$$

The reservation wedge continues to be defined analogously to the Frischian wedge, yet now (as in the intensive-margin case), as as a fixed point $1-\xi^*_{t,t+\Delta}$, implicitly defined as the hypothetical prevailing wedge $1-\Xi_{t,t+\Delta}$ of duration Δ that would leave the worker indifferent between working for that time interval $[t, t+\Delta]$ and not working:

$$1-\xi^*_{t,t+\Delta} = \frac{v_{it}}{y_{it}\cdot\lambda_{it}(1-\xi^*_{t,t+\Delta})} \tag{21}$$

Non-Frischian wedges $1-\Xi_{t,t+\Delta}$ with $\Delta > 0$ capture two effects. First, the substitution effect going along the the reservation wedge distribution holding λ constant. This is the Frischian setting we have so far studied by assuming the period Δ to be infinitesimal (or alternatively permitting the lump-sum tax T to offset any wealth effects). Second, a wealth effect may also shift $\lambda_{it}(1-\Xi_{t,t+\Delta})$, generally working into the other direction.[9]

In principle, even in the context of wealth effects, a Frischian variation can be induced in practice or theory by offsetting lump sum taxes or transfers. However, this may not be useful descriptions of real-world labor supply choices. To *quantitatively* evaluate the divergence between uncompensated and Frischian labor supply curves, we assess the gap between the Frischian and an uncompensated labor supply curves of the calibrated models we discuss in detail in Section 4: a representative household with a 2.5 Frisch labor supply isoelasticity, a finitely-lived atomistic household with an intensive margin, and a heterogeneous agent model with uninsured wage shocks and borrowing constraints. Computational details for these exercises are in Appendix A.

In each exercise, we simulate an unexpected aggregate-wedge perturbation lasting for one quarter, a useful horizon for business-cycle frequencies, and compare the uncompensated labor supply response to the reservation-wedge-implied Frisch labor supply curve. Across all three models, the Frischian and uncompensated aggregate labor supply curves are very similar, implying that the Frischian curve from the reservation wedges, at least in these models, provides a good approximation for uncompensated labor supply responses even at a quarterly frequency. Figure 1 provides these quantitative evaluations.

A further potential source of attenuation comes in the form of larger income effects in contexts with asset liquidation frictions, such as those modeled in (Kaplan, Violante, and Weidner, 2014; Kaplan, Moll, and Violante, 2018), in which case even some high-income and high-net-wealth individuals households act liquidity constrained.

[9]Consider an application of our framework to the canonical example of balanced-growth (with $\sigma = 1$) preferences separable and isoelastic in consumption $u(c,h) = \frac{c^{1-\sigma}}{1-\sigma} + v(h)$, and labor earnings as the only source of income, and with amortized (hence smoothed as consumption) pre-wedge present value of earnings Y_{it}, for a permanent wedge $1-\Xi_{t,t+\infty}$:

$$e^*_{it} = \begin{cases} 0 & \text{if} \quad (1-\Xi_{t,t+\infty})y_{it}(1-\Xi_{t,t+\infty})^{-\sigma}\cdot Y_{it}^{-\sigma} < v_{it} \\ 1 & \text{if} \quad (1-\Xi_{t,t+\infty})y_{it}(1-\Xi_{t,t+\infty})^{-\sigma}\cdot Y_{it}^{-\sigma} \geq v_{it} \end{cases} \tag{22}$$

For $\sigma = 1$, the employment policy is independent of the wedge: the substitution effect, movement *along* the aggregate labor supply curve, is perfectly offset by the wealth effect, which shifts the curve towards the original employment level, generating the *extensive-margin analogue of constant inelastic long-run labor supply*.

Net vs. Gross Earnings, Nonemployment Subsidies, and Home Production Monetary (non-disutility) opportunity costs of working, such as various welfare programs (for measurement of these average costs in the context of a representative household, across countries and the U.S. business cycle, see Prescott, 2004; Chodorow-Reich and Karabarbounis, 2016) or home production (Benhabib, Rogerson, and Wright, 1991; Aguiar, Hurst, and Karabarbounis, 2013), which we denote as b_{it}, affect labor supply by shaping the outside option to market work.[10] The wedge framework accommodates these features and clarifies that they act, on the extensive margin, by shifting the threshold of the marginal individual, and interact with wedge-shifts to the degree that they are wedge-sensitive.

Two cases are useful to consider. First, if (the now more broadly defined) opportunity costs b_{it} is subject to the wedge (e.g., home production if shifting with TFP as the shifter), it can be folded into a richer *net* potential earnings concept: *gross* potential earnings $y_{it} = \tilde{y}_{it} - b_{it}$ minus b_{it}. The wedge logic then goes through:

$$1 - \xi_{it}^* = \frac{v_{it}}{(\tilde{y}_{it} - b_{it})\lambda_{it}} = \frac{v_{it}}{\tilde{y}_{it}\left(1 - \frac{b_{it}}{\tilde{y}_i t}\right)\lambda_{it}} = \frac{v_{it}}{y_{it}\lambda_{it}} \tag{23}$$

where $\frac{b_{it}}{\tilde{y}_i t}$ is a "replacement rate".

Second, if b_{it} is not marked up by the wedge (e.g., acyclical nonemployment subsidies), then b_{it}, marked up by λ_{it}, can fold into disutility of labor $v_{it} = v_{it} + b_{it}\lambda_{it}$:

$$1 - \xi_{it}^* = \frac{v_{it} + b_{it}\lambda_{it}}{\tilde{y}_{it}\lambda_{it}} = \frac{v_{it}}{y_{it}\lambda_{it}} - \frac{b_{it}}{y_{it}} = \frac{\tilde{v}_{it}}{y_{it}\lambda_{it}} \tag{24}$$

Non-Wage Job Amenities Non-wage job amenities (Mas and Pallais, 2017; Hall and Mueller, 2018) can simply be folded into the now *net* disutility of work v_{it}^j for each job j, then encompassing all non-monetary flow benefits entering directly the utility function.

2.6 Beyond the Spot Labor Market Benchmark

So far we have characterized desired labor supply in form of reservation wedges from the perspective of a spot labor market as well as "gross-of-frictions". We here briefly discuss potential deviations from the spot frictionless benchmark. First, long-term jobs may generate dynamic considerations in committing to a job. For example, Mui and Schoefer (2018) develop a framework of otherwise standard labor supply in which jobs are long-lasting and exogenously separating with probability δ, building on matching models. The authors show that the wage concept can be cast as a standard spot condition augmented to reflect market-timing considerations, overall resulting in a "user cost of labor" (akin to Kudlyak (2014) for labor demand in a matching model setting).

Second, incentives to accumulate human capital on the job, as in Imai and Keane (2004) and the related skill-loss perspective of Ljungqvist and Sargent (2006, 2008). Here, potential earnings increase in the number of employment in the previous periods, generating a forward-looking

[10] Taxes $T(.)$, since taken as parametric in labor supply, do not capture such terms.

investment incentive for labor supply today:

Third, so far we have characterized desired labor supply "gross-of-frictions" from the perspective of a spot labor market. The "net-of-frictions" counterpart would take into account non-spot market structures, and frictions. To fix ideas, consider the discrete choice setup in which these costs are monetary as an ad-hoc adjustment lump-sum cost $\lambda_{it} \cdot c_{it} \cdot \mathbb{1}\left(e_{it} \neq e_{i,t-1}\right)$. This cost shrink the set of individuals adjusting to a transitory wedge shift, specifically depending on the employment status quo: an employed worker may – gross of frictions – prefer to take off a month for a vacation in response to small wage changes, while net of the adjustment costs, she may prefer to stay put.

Fourth, by studying desired spot-market labor supply rather but falling short of studying potential deviations therein with realized employment allocations, our framework treats the unemployed more similarly to the employed rather than those out of the labor force (as the unemployed will have have wedges below one i.e. they would like to work yet perhaps due to search frictions have yet to obtain an employment opportunity). This classification contrasts with the focus on how to divide the nonemployed into the unemployed vs. out of the labor force as in][]flinn1983unemployment. Dedicated treatments of labor supply notions in the context of search frictions are provided by Hall (2009) , Krusell, Mukoyama, Rogerson, and Sahin (2017) and Cairo, Fujita, and Morales-Jimenez (2019).

3 Empirical Reservation Wedges

Having robustly formulated the theoretical extensive-margin aggregate labor supply curves as the reservation wedge distribution, we now trace out the empirical counterpart by directly asking individuals about their individual reservation wedges in a custom U.S. household survey. We follow three steps:

E1 Elicit the individual-level reservation wedge $1 - \hat{\xi}^*_{it}$.

E2 Construct and plot CDF $F_t(1 - \hat{\xi}^*)$, the aggregate labor supply curve.

E3 Back out the extensive margin labor supply elasticities from the CDF.

3.1 Eliciting Individual-Level Reservation Wedges

Our primary data set is a custom survey of U.S. households comprising all labor force segments, of which we ask a tailored question eliciting directly their idiosyncratic reservation wedges. We are to our knowledge the first to elicit the reservation wage (let alone wedge) concepts from non-job-searchers.

Survey We implement this approach with a tailored survey questionnaire in a nationally representative U.S. survey of 2,000 respondents. Our survey was fielded by NORC (University of Chicago), in a sample drawn from the AmeriSpeak Omnibus survey program, and aimed to cover a representative cross-section of U.S. households. We also obtain additional demographic variables permitting us to study the covariates of the wedges and to conduct subsample analyses.[11]

Ideal Measure of the Reservation Wedge To fix ideas, we start with the ideal survey question tightly mirroring the theoretical reservation wedge, asked of the employed [nonemployed]:

> You are currently [non-]employed. Suppose the following thought experiment: you (and only you) receive an additional temporary linear incremental tax [or subsidy] on your take-home earnings (at whichever hours or job you may choose to work). At what incremental tax [or subsidy] rate would you be indifferent between working for this period and not (at whichever job would be your best choice at that given tax [subsidy] rate)?

This approach invokes an additional tax [subsidy] on top of any potentially pre-existing taxes and frictions, thereby normalizing the marginal worker's reservation wedge to one i.e. t $1 - \hat{\xi}^*_{it} = 1$. One therefore does not have to take a stance on the *level* of the already-prevailing aggregate labor wedge in the data. Formally, we would elicit this normalized wedge $1 - \hat{\xi}^*_{it}$ corresponding to:

$$v_{it} = (1 - \hat{\xi}^*_{it}) \left[(1 - \Xi_t) y_{it}\right] \lambda_{it} \tag{25}$$

$$\Leftrightarrow 1 - \hat{\xi}^*_{it} = \frac{v_{it}}{\left[(1 - \Xi_t) y_{it}\right] \lambda_{it}} \tag{26}$$

$$= \frac{1 - \xi^*_{it}}{1 - \Xi_t} \tag{27}$$

Actual Implementation of Reservation Wedge Measure in U.S. Household Survey The actual questions we implement are the result of piloting and iterations with survey administrators, leading us to formulate relatively concrete scenarios. While the ideal question formulation permits job switching and reoptimization (see Section 2.5), we in fact invoke a "job-constant" perspective (at the prevailing wage).[12] Throughout, we keep the frequency of the Frischian wage change constant at one month. We discuss caveats and trade-offs of the specific implementation in Section 3.4.

Below are our questions for each of the three labor force statuses. [13]

[11] Our survey was conducted in two waves conducted in March and April, 2019. NORC provides sample probability weights to match the American adult demographic. We re-scale the weights in each wave to represent the proportion of the total sample obtained from each wave. The first wave, dated March 19th 2019, contributed 809 observations with non-missing wedge responses (48.2% of the total sample); the second wave, dated April 19th 2019, contributed 870 individuals with non-missing wedge responses (51.8% of the total sample). Then, we reweight the observations so that the weighted labor force status proportions precisely match the February 2019 BLS population shares for employment, labor force participation, and unemployment (although the raw sample was close to the BLS targets).

[12] Formally, the survey wedges are $(1-\widetilde{\widetilde{\xi}}^*_{it}) \left[(1 - \Xi_t) y_{it,1-\Xi_t}\right] \lambda_{it} \equiv v_{it,1-\Xi_t}$, and so we elicit $1-\widetilde{\widetilde{\xi}}^*_{it} = \frac{v_{it,1-\Xi_t}}{\left[(1-\Xi_t) y_{it,1-\Xi_t}\right] \lambda_{it}} = \frac{1-\tilde{\xi}^*_{it}}{1-\Xi_t}$, which is normalized around one for the marginal worker even in the presence of pre-existing tax-like wedges.

[13] We feature an additional variant of the question for the temporarily laid off that mirrors that of the employed (supposing the respondent is back at the previous job). We do not ask the self-employed, given the missing wage concept. We do not differentiate multiple-job holders.

Question for the Employed The question presents the employed worker with a scenario forcing her to trade off the level of reduced earnings with an indifferent point of employment vs. nonemployment. To keep the scenario sufficiently realistic, we allude to a vacation. To avoid capturing frictions associated with job mobility (an insight from piloting), we also guarantee the worker to be able to return to the original job in this specification:

> The following is a hypothetical situation we ask you to think about regarding your current job, so please read [listen] carefully and try to think about what you would do if presented with this choice.
>
> Suppose, for reasons unrelated to you, your employer offers you the following choice: Either you take unpaid time off from work for one month, or you stay in your job for that month and only receive a fraction of your regular salary. No matter what choice you take, after the month is over, your salary will return to normal.
>
> In this hypothetical scenario, you cannot take an additional job to make up for the lost income during that month.
>
> Assume this choice is real and you have to make it. At what point would the cut in your salary be just large enough that you would choose the unpaid month of time off over working for the month at that lower salary?
>
> For example, an answer of 5% means that a 5% wage cut would be the point where you would choose to take unpaid time off for the month instead of working for 5% lower pay during that month. But if the wage cut was less than 5%, you would instead choose to work for that than take unpaid time off. Choose any percentage between 1% to 100%, where the cut wage cut is just large enough that you would prefer to not work at all for no pay than work at reduced pay for that month.

Question for the Unemployed For the unemployed, while reservation wedge questions have a long history in empirical research, our challenge was to keep the answer comparable to the Frischian perspective presented to the other respondents. We therefore induce the scenario at which a prospective job permits a one-month earlier start date than regular, albeit at a wage reduction. The particular reason is left unspecified, although we clarify that this interim month is to be spent in nonemployment:

> The following is a hypothetical situation we ask you to think about a potential job you may be looking for, so please read [listen] carefully and try to think about what you would do if presented with this choice.
>
> Suppose you have found the kind of job you are looking for and the employer would like to hire you. The regular start date for the job is one month away. As an alternative, your employer offers you the option to start working immediately, rather than waiting a month.
>
> However, if you chose to start work immediately, for that first month, you will only receive a fraction of the regular salary. The job is otherwise exactly the same. No matter what choice you take, after the month is over, the salary will then resume at the regular salary.

> In this hypothetical scenario, you cannot take an additional job to make up for the lost income during that month.
>
> Assume this choice is real and you have to make it. At what point would the cut in your salary be just large enough that you would choose the waiting a month without working and without the salary over starting the job immediately for the first month at that lower salary?
>
> For example, an answer of 5% means that a 5% wage cut would be the point where you would choose to wait a month without working instead of working for % lower pay during that month. But if the wage cut was less than 5%, you would instead choose to work at that wage than wait a month without working. Choose any percentage between 1% to 100%, where the cut wage cut is just large enough that you would prefer to not work at all for no pay than work at reduced pay for that month.

Question for the Out of the Labor Force Those out of the labor force presented the most significant challenge in formulating our questions. This group is comprised of those who are least likely to consider taking up employment (for example, the disabled, the retired, or students), but also of some marginal workers (as evidenced by the high rate of transitions between employment and nonemployment).

For this group, we ask about the required *subsidy* to induce a respondent into marginal employment, since by declaration and revealed preference these individuals likely have reservation wages exceeding their expected potential wages. Crucially, for our Frischian perspective, this wage change is only supposed to occur for a single month. For concreteness and realism, we implement this scenario in the form of a sign-up bonus on top of the first-month salary. We also specify that the employment relationship is to last for at least (rather than exactly) one month:

> The following is a hypothetical situation that may not have anything to do with your actual situation, but please read [listen] carefully and try to think about what you would do if presented with this choice.
>
> Think of the range of jobs that you would realistically be offered if you searched for jobs (even if you currently are not looking for a job and may not accept any of these potential jobs).
>
> Suppose you had such job offers in hand. Currently you would likely not take such jobs, at least not at the usual salary. However, suppose the employer were nevertheless trying hard to recruit you, specifically by offering an additional sign-up bonus. The requirement to receive the bonus is that you will work for at least one month. The bonus comes as a raise of the first month's salary. This sign-up bonus will only be paid in the first month (on top of the regular salary that month), afterwards the salary returns to the regular salary.
>
> Assume this choice is real and you have to make it. We would like to learn whether there is a point at which the bonus in the first month is just high enough that you would take the job.
>
> 5% means you would take the job if your employer paid a bonus of just 5% of the regular salary in the first month. 100% means you would require a bonus as large as

the regular salary. 500% would mean you require a bonus equal to five times as large as the regular salary.

Choose any percentage bonus that would be just high enough that you would take the job. You can enter a very high number (e.g. 100,000%) if you think you would not take any job, even if it paid a lot.

3.2 Results: The Empirical Aggregate Labor Supply Curve

Distribution of the Reservation Wedge We present histograms of the empirical reservation wedges from the reported reservation wedges in the NORC survey data in the histogram in Figure 2 Panel (a), where gray (white) [black] bars denote observations from the sample that are employed (unemployed) [out of the labor force]. We report the summary statistics of the distribution of the log reservation wedge in Table 1. To illustrate the local behavior of the labor supply curve around marginal workers, we report the share of the population in a given distance from the prevailing unit wedge in Table 2.

The empirical histogram of the wedge distribution exhibits a large mass around one – where the reservation wage is close to the individual's actual wage i.e. the location of marginal workers. Globally, the distribution is widely dispersed, implying that the typical worker is inframarginal in that she derives considerable worker surplus (or, in the case of the nonemployed, would suffer considerable net disutility) from employment with tremendous heterogeneity in worker surplus.

Aggregate Labor Supply Curves To trace out the aggregate extensive-margin labor supply curve, we aggregate the micro wedges into a cumulative distribution function. Figure 2 Panel (b) plots the CDF of the empirical distribution of the empirical reservation wedges, with the cumulative distribution function $F(1-\xi^*)$ on the x-axis, and the wedge on the x-axis $1-\xi^*$.

To facilitate visual inspection with regards to implied elasticities, we additionally take logs of both axes, thereby plotting changes in desired $\log(E^*)$ against changes in $\log(1-\Xi)$. We do so in Figure 3 and 4 (which is simply Figure 3 zoomed into the local behavior). We also report descriptive statistics in Tables 1.

Implied Arc Elasticities Complementing this interpretation, in Table 2, we report local arc elasticities of the empirical labor supply curve given by Equation (8) defined in Section 2.4:

$$\epsilon_{E,(1-\Xi)\to(1-\Xi')} = \frac{F(1-\Xi')-F(1-\Xi)}{F(1-\Xi)} \Bigg/ \frac{(1-\Xi')-(1-\Xi)}{1-\Xi}$$

To detect potential non-constant elasticities or asymmetries, we construct a set of arc elasticities using varying sizes of wedge deviations (upwards, downwards, and equally spaced around zero). We additionally plot a series of arc elasticities of the empirical labor supply curve as a function of the wedge deviation from the unit wedge and hence the employment baseline in Figure 5 (in solid curves with hollow circles; the figure additionally contains model analogues we develop in subsequent Section 4 and a fitted line we derive in Section 5).

Large Local Elasticities Inspecting the empirical curve, we find a *local* Frisch elasticity of desired extensive-margin labor supply of around 3 (even higher with very small pertubations). The underlying concentration of marginal workers mirrors, in an attenuated way, intuitions from models of homogeneity (Hansen, 1985).

Nonconstancy: Smaller Arc Elasticities to Large (In Particular Upward) Deviations Non-local perturbations imply dramatically lower arc elasticities to large wedge changes than local ones. That is, while locally an increase in the benefit to working crowds in nearly 2.26 percent of the employment rate around a 1% change in the wedge (implying an elasticity of $\frac{d(\text{Emp/Pop})}{\text{Emp/Pop}}/0.01 = \frac{0.0226}{0.631}/0.01 = 3.72$), the implied elasticity falls to 0.96 when considering a larger wedge pertubations of 10%. Downward, arc elasticities fall falling from 5.66 for the 1% interval to 1.68 for the 10% drop in the return to working.

The non-constant elasticities is salient in the arc elasticities plot in Figure 5. Arc elasticities are largest around the baseline prevailing wedge, and decrease in either direction of the curve. Taken at face value, Figure 5 suggests that constant elasticities do not provide a realistic description of the *global* aggregate extensive-margin labor supply curve.

This empirical pattern has two main implications for modeling and interpretation of empirical evidence on labor supply. First, when resorting to constant-elasticity setups nevertheless, a high elasticity may be warranted for small perturbations (as implied by marginal labor product shifts in labor-market-clearing business cycle models), than when studying, e.g., large temporary work subsidies or tax holidays.

Second and implying an empirical trade-off, estimated small *arc* elasticities identifed off large increases in the benefit to working may mask large local elasticities. We illustrate this point with some particularly compelling quasi-experiments from which Chetty, Guren, Manoli, and Weber (2012) infer arc elasticites at the extensive margin, as the variation is fairly transitory, hence plausibly yielding Frischian labor supply behavior. The first context is a tax holiday in Iceland, studied by Bianchi, Gudmundsson, and Zoega (2001), which raised average net of tax rate (in our model: $1 - \Xi_t$) from 0.855 to 1.000 for one year (and then 0.92 for another year), in response to which positive employment effects implied an elasticity of 0.42. Second, the Self Sufficiency Program in Canada, studied by Card and Hyslop (2005), raised average net of tax rates by dramatically more, from 0.25 to 0.83, for 36 months, with an implied employment elasticity of 0.38. Yet, fitting these large variations in our curve, the experiments would occupy points far on the right, where the nonconstant empirical curve exhibits smaller elasticities well below 1.00 too. Our empirical benchmark, taken at face value, raises the possibility that these estimates of small elasticities from large variation can, and in our empirical curve do, mask very large local elasticities.[14] We illustrate how the nonconstancy plays out for macro, business cycle contexts in Section 5.

[14]To some degree, the nonconstant elasticity is of course expected, as the employment rate cannot exceed 1.00. Conversely, the large macro elasticity benchmarks of around 2.5 cited by Chetty, Guren, Manoli, and Weber (2012) would, out of a baseline employment rate of 0.65, imply rates exceeding 100% for some of the case studies the authors discussed. By contrast, Martinez, Saez, and Siegenthaler (2018) also study a large tax holiday, in Switzerland, and find no treatment effects on employment rates, and therefore implying small elasticities across all intermediate arcs.

3.3 Covariates of the Reservation Wedges

We now ask which micro covariates are associated with between-worker variation in reservation wedges.[15] We regress the logged reservation wedge on covariates in Tables 3 and 4 (controling for labor force status and hence studying within-status variation).[16] We conduct covariate-by-covariate regressions (incl. baseline controls) and then one kitchen-sink multivariate regression in the last column. In Appendix Figure A1, we additionally portray some results graphically in histograms of subgroups and age gradients.

To increase sample size, we have also supplemented our analysis with larger existing surveys of the German population, namely the German Socio-Economic Panel (GSOEP) and Panel Study Labour Market and Social Security (PASS), which elicit standard reservation *wages* from subpopulations. We proxy for an individual's reservation *wedges* as the ratio of reservation wages to lagged or expected earnings. We describe the surveys and the construction of these reservation wedge proxies in Appendix B.1, and report the associated regressions in Appendix Tables A2 (GSOEP) and A3 (PASS).

Age Life cycle models imply that marginal workers arise predominantly from the extremes of the age distribution, due to the triangle-shaped productivity profile and the resulting cutoff ages for labor force participation (see chiefly the Rogerson and Wallenius, 2008, model, reviewed in Section 4). Appendix Figure A1 (f) plots the wedge-age gradient, binning ages to the nearest multiple of five. Before age 60, the relationship is flat, then wedges increase after age 60. Perhaps the flat wedges among the younger reflects training on the job incentives, as in Imai and Keane (2004).[17]

Sex The regression analysis reveals a noisily estimated 10% higher reservation wage among the female population on average.[18]

Financials High net and gross asset to income ratio individuals (perhaps with a high λ and low y) exhibit higher reservation wedges. By contrast, though noisily estimated, the credit card debt (binned) (continuous amounts not provided) lead to lower wedges, perhaps indicating higher λ as in heterogeneous agent models with borrowing constraint (reviewed in Section 4).[19]

Education Worker surplus should increase in education (e.g., Oi, 1962). For the U.S. survey, we do find a noisily estimated but negative effect of college education on the wedge (omitted category:

[15] Our analysis of covariates of marginal workers complements revealed-preference identification by Jäger, Schoefer, and Zweimüller (2018), who study complier-separators in response to UI benefit extensions, and isolate their attributes in a complier analysis.

[16] The regression sample shrinks by a quarter due to missing covariates (from previous waves).

[17] Appendix Figure A1 Panel (e) plots the gradient for the GSOEP (unemployed). Here, the younger workers (aged 20 to 25) have higher wedges, consistent with lower productivity or higher-valued non-work outside options such as schooling. Interestingly, *older* workers' reservation wedge proxies are nearly flat and finally fall – inconsistent with the RW prediction.

[18] In GSOEP, while wedges of male and female workers are very similar, the histograms by sex in Figure A1 (a) reveals that female workers have a larger mass of "very inframarginal" workers on the employment side (left of 1), somewhat shifted from the mass right below 1. Our U.S. survey does not clearly echo this result in the associated histogram in Panel (b), perhaps because the GSOEP survey relies on the unemployed.

[19] In GSOEP, where we do not see financials, perhaps counterintuitively, satisfaction with income has a negative effect, while concern about ones' finances has a positive one.

less than high school diploma).[20]

3.4 Limitations and Trade-Offs

We here discuss a series of caveats to our empirical labor supply curve, the shape of which we will however take at face value for the rest of the paper.

Micro vs Aggregate Pertubation First, we induce a scenario in which the variation in the wedge is at the micro level, as we aim to have an all-else-equal scenario that more directly maps into the baseline model. Yet, it is perceivable that due to shifts in stigma, leisure complementarities, frictions in labor supply adjustment that differ by idiosyncratic vs. coordinated adjustment, or wealth effects resulting in added worker effects, the micro responses may differ in response to an aggregate shock.

Spot Market vs. Adjustment Frictions Second and more specifically, our formulation in particular for the employed evokes a spot-market scenario in which adjustment frictions are attenuated and a scenario in which return to work at least implicitly permitted. Frictions may detach desired from actual employment allocations. We relegate a tentative assessment of these issues into Appendix Section B.2, where we compare respondents' *realized* employment outcomes past, present and future (using the panel structure in the surveys and administrative data) with their idiosyncratic reservation wedge statements. We find some evidence that in the micro data, realized employment outcomes correlated – but far from perfectly so – with the predictions from the reservation wedge measures, perhaps suggesting either rationed labor supply due to frictions (or mismeasurement or imperfect persistence of the wedges across years).

Response Quality Third and relatedly, as with related survey measures of contingent valuation more generally, and most relatedly existing reservation wage measures among the unemployed, these survey measures may be of poor quality. Yet, in our setting, excess dispersion in form of noise would generate lower elasticities rather than higher local elasticities. The specific mismeasurement of concern to us is respondents overestimate the degree to which they are willing to change their employment status (and the covariate analysis in Section 3.3 did convey some meaningful relationships with observables).

Stationary vs. Time-Dependent Distribution Fourth, our survey elicits the labor supply curve for one cross-section representative of the U.S. population only; in subsequent Section 5 we assume this economy to reflect a steady-state with a stationary Frischian distribution from which we study deviations throughout U.S. history.

Uncompensated Variation Fifth, in practice in the survey, we set the duration of the wage perturbation to one month to balance sufficient shortness to plausibly induce Frischian variation with sufficient length to denote a meaningful extensive-margin choice. An interesting extension

[20] In Appendix Figure A2 Panel (f), we plot average reservation wedges by education level for GSOEP (the survey with the richest education information). The employment rate of highly-educated individuals is higher and the ratio of the reservation wages to lagged wages is lower. The GSOEP and PASS regressions reveal a significantly negative effect on the wedge of years of education.

would be to *empirically* study measured wedges from longer durations, for example by instead invoking a quarter-long or even year-long temporary wedge. On the one hand, potential wealth effects will grow with longer duration. On the other hand, adjustment costs may be more easily overcome, working in the opposite direction.

In Section 2.5, we have discussed such wealth effects and shown that for the models discussed below in Section 4, the uncompensated and Frischian/wedge-based labor supply curves are extremely similar, even at the *quarterly* (as in the simulations) rather than monthly (as in our survey) frequency, reported in Figure 1. Hence, the Frischian i.e. uncompensated aggregate labor supply curve from a month-long scenario provides a good approximation – and hence calibration target for – a model's Frischian i.e. wedge-based curve.

4 Meta-Analysis of Existing Models Compared to Data

We now compare the empirical curve with the model-implied labor supply curves, using the reservation wedge distribution as a unifying framework between models, and in turn between models the data. No existing model will provide an accurate description of extensive-margin employment preferences, locally or globally.

4.1 Overview of Results

We plot the wedge distributions as aggregate labor supply curves (in changes) for the models we review in detail in Section 4, against the *empirical* curve from our survey for the U.S. population, in Figure 3 and 4 (which is simply Figure 3 zoomed into the local behavior). In each of our modeling exercises, we parameterize the model so that the steady state employment rate (the employment to population ratio) is 60.7%, an empirical target that reflects the U.S. 16+ civilian employment population ratio in February 2019 from the BLS (FRED series EMRATIO), also reflected in our empirical survey.[21] We plot the arc elasticities of each of the models' labor supply curves as a function of the wedge deviation in Figure 5. We report descriptive statistics and arc elasticities for various intervals in Tables 1 and 2 respectively. In each model, we normalize the prevailing aggregate wedge around 1, without loss of generality, and will study deviations from this baseline wedge (or any preexisting taxes).

Homogeneity (Hansen, 1985) Qualitatively, the empirical wedge distribution does mirror some intuitions of the homogeneity model of Hansen (1985); Rogerson (1988) (and also textbook DMP models without heterogeneity), as a large set of the workforce appears to be bunching around the prevailing wedge, generating the large local elasticities. However, as is evident from the histogram of reservation wedges in Figure 2 Panel (a), the empirical reservation wedges exhibit tremendous heterogeneity, consistent with models of heterogeneity in job surplus (Mortensen and Pissarides, 1994; Bils, Chang, and Kim, 2012; Jäger, Schoefer, and Zweimüller, 2018) and present in lifecycle models Rogerson and Wallenius (2008) or with heterogeneous disutility of labor supply (Gali, 2015;

[21] Rather than restricting to prime working age population, we target a fuller population definition because our models include explicit lifecycle perspectives such as labor force entry or retirement (Rogerson and Wallenius, 2008). So our survey targets workers 18 and older without an upper age limit.

Boppart and Krusell, 2016), or potential earnings (as in the heterogeneous agent model).[22] We now discuss the detailed shapes of these models in detail.

Isoelasticities (MaCurdy, 1981) We include the 0.32 and 2.5 isoelasticity "MaCurdy (1981)" setups we present and microfound in Section 4. We follow (Chetty, Guren, Manoli, and Weber, 2012) in declaring the 0.32 case to correspond to the yet an quasi-experimental estimates of realized employment adjustment to short-run and large net-wage changes (Chetty, Guren, Manoli, and Weber, 2012), whereas the 2.5 isoelasticity case is a "large elasticity" the authors associate with various macroeconomic calibrations in particular equilibrium business cycle models.

Neither the low nor the high Frisch elasticity curves accurately describe the empirical *global* labor supply curve. Interestingly, around the baseline prevailing wedge, the local elasticity is closer to the large elasticity case. To the left, a high elasticity of around 3 may best describe the empirical curve. However, as one examines larger intervals in particular positive pertubations, the data exhibit smaller arc elasticities below 1.00, towards 0.50.

Rogerson and Wallenius (2008) This model generates a high local elasticity. In the upwards direction, it generates a nearly constant elasticity, mirroring the 2.5 isoelasticity line. Interesting, the model generates some asymmetry, implying smaller elasticities upward than downward, qualitatively in line with our empirical benchmark. Quantitatively however, the model misses the steep decline in the elasticity in response to positive return-to-work shifts, where the empirical benchmark implies elasticities below one and towards 0.5, whereas the model-implied elasticities remain above 2.[23]

Heterogeneous Agent Model The microfoundations of the shape of the extensive-margin labor supply curve are substantially less transparent in models with heterogeneous agents and stochastic potential-earnings processes, since individuals in these models are often heterogeneous across multiple dimensions, and arise from equilibrium outcomes. The reservation wedges, at the micro level, summarize the sources of heterogeneity in labor supply preferences, and plotting and analyzing their distribution reveals the overall Frischian behavior of the labor supply block.

The heterogeneous agent model generates very small local labor supply elasticities (0.12–0.31) upward, but exhibits larger (up to 0.72) elasticities downward, albeit only briefly. Qualitatively, these asymmetries are in line with the empirical curve. But the amplitudes of the deviations are dramatically compressed, with the model implying too small of elasticities throughout, except perhaps for very large increases in the benefit to working about 20%. Interestingly, the model then generates fairly stable elasticities for larger pertubations, asymptotes quite tightly towards the 0.32 benchmark corresponding to the Chetty, Guren, Manoli, and Weber (2012) quasi-experimental estimates.

[22] The histogram also exhibits some likely spurious mass points at 0.5 and 1.5, likely due to rounding.

[23] Consistent with our global clarification, Chetty et al. (2012), who simulate large empirical wage increases in the model, find it to exhibit large Frisch elasticities.

4.2 Full Derivation: Models Recast in Reservation Wedge Framework

We present a meta-analysis applying the reservation-wedge approach as a unifying bridge between structurally different labor supply blocks, proceeding in three steps:

- M1 Construct the individual-level reservation wedge $1-\xi^*_{it}$ in the model at hand.
- M2 Compute its equilibrium distribution $F_t(1-\xi^*_{it})$, and plot the implied aggregate labor supply curve.
- M3 Compute the extensive margin labor supply elasticity at $1-\Xi_t$ as $\frac{(1-\Xi_t)f_t(1-\Xi)}{F_t(1-\Xi_t)}$.

We parameterize each model to a steady state employment rate $F_t(1-\Xi_t) = 60.7\%$, an empirical target that reflects the U.S. 16+ civilian employment population ratio in February 2019 from the BLS (FRED series EMRATIO). [24] The relevant parameters for our calibrated models in this meta-analysis are in Table 5. Figure 6 plots additional model-specific wedge histograms and supplementary items.

4.2.1 Representative Household: Full Insurance and "Command" Labor Supply

A common specification of aggregate labor supply appeals to a large representative household, comprised of a unit mass of individual members, which we here explicitly index by $i \in [0,1]$. The large household has a *pooled* budget constraint. Micro utility $u_i(c_{it}) - e_{it}v_{it}$ is separable, where $e_{it} \in \{0,1\}$ is an employment indicator. Potential earnings are y_{it}. There is potentially some uncertainty over the path of wages and interest rates. The utilitarian household head assigns consumption levels and employment statuses to its individual members: [25]

$$\max_{\{c_{it},e_{it}\}_i,A_t} \mathbb{E}_0 \sum_{t=0}^{\infty} \int_0^1 \left[u_i(c_{it}) - e_{it}v_{it}\right] di \tag{28}$$

$$\text{s.t. } A_t + \int_0^1 c_{it} di \le A_{t-1}(1+r_{t-1}) + \int_0^1 (1-\Xi_t) y_{it} e_{it} di + T_t \tag{29}$$

Full (cross-sectional) insurance implies that the marginal utility of consumption is optimally set homogeneous across households, equal to the multiplier on the pooled budget constraint:

$$\overline{\lambda}_t = \frac{\partial u_i(c_{it})}{\partial c_{it}} \;\; \forall\, i \tag{30}$$

hence eliminating λ_{it} as a source of wedge heterogeneity even with heterogeneity in consumption utility $u_i(\cdot)$. Due to spot jobs, expectations and intertemporal aspects are subsumed in $\overline{\lambda_t}$.

First, we define the allocative micro reservation wedge in this large-household structure, here rendering the household *head* indifferent between sending member i to employment rather than

[24] Rather than restricting to prime working ages, our sample is 18 an older, to capture lifecycle margins including labor force entry and retirement (as in e.g. Rogerson and Wallenius, 2008).

[25] We take a perspective, akin to Gali (2015), that the household head directly assigns allocations. Hansen (1985) and Rogerson (1988) present incentive-compatible lotteries. The set-up is equivalent to a representative household with utility function $U(c_t, E_t) = \log(c_t) - \overline{v}E_t$, with intratemporal first-order condition $\overline{\lambda}_t\overline{w}_t = \overline{v}$.

nonemployment (where we can index an individual i by her disutility-earnings type vy:

$$1-\xi_{it}^{*}=\frac{v_{it}}{\overline{\lambda}_{t}y_{it}} \tag{31}$$

$$=1-\xi_{vyt}^{*} \tag{32}$$

Optimal labor supply assigns each i employment status $e_{it}=e_{vyt}\in\{0,1\}$ given by a wedge cutoff:

$$e_{vyt}^{*}=\begin{cases}0 & \text{if} \quad 1-\xi_{vyt}^{*}>1-\Xi_{t}\\ 1 & \text{if} \quad 1-\xi_{vyt}^{*}\leq 1-\Xi_{t}\end{cases} \tag{33}$$

Second, we trace out the *aggregate* labor supply curve from the distribution of the reservation wedge, which in turn subsumes the detailed potential heterogeneity in wages and labor supply disutilities. Employment E_t is equal to the mass of workers with $1-\xi_{it}^{*}\leq 1-\Xi_{t}$:

$$E_{t}=F_{t}(1-\Xi_{t})=P\left(1-\xi_{it}\leq 1-\Xi\right)=P\left(\frac{v_{it}}{y_{it}\overline{\lambda}_{t}}\leq 1-\Xi_{t}\right)=P\left(\frac{v_{it}}{y_{it}}\leq(1-\Xi_{t})\overline{\lambda}_{t}\right) \tag{34}$$

$$=\int_{-\infty}^{\infty}\int_{-\infty}^{\infty}\mathbb{1}\left[\frac{v}{y}\leq(1-\Xi_{t})\overline{\lambda}_{t}\right]dG_{t}(v,y) \tag{35}$$

where $G_t(v,y)$ is the CDF of the joint distribution of v and y. Below we review specific cases of this general class of labor supply block.

Hansen (1985) The setup nests the model of indivisible labor and homogeneous households by Hansen (1985), where specifically $w_{it}=\overline{y}_{t}$ and $v_{it}=\overline{v}=A\ln(1-h_{it})\forall i$, with one exogenous hours option $h_{it}\in\{0,\widetilde{h}>0\}$, where we normalize $\widetilde{h}=1$.

First, all individuals have the same wedge – i.e. all are exactly marginal:

$$1-\xi_{it}^{*}=1-\bar{\xi}_{t}^{*}=\frac{\overline{v}}{\overline{\lambda}_{t}\overline{y}_{t}} \tag{36}$$

Second, the wedge distribution, which we plot in Figure 6 (a), is degenerate.

Third, the Frisch elasticity is infinite at $1-\Xi_t$. Interior solutions are obtained through λ_t (decreasing marginal utility from consumption).

Heterogeneity Only in Disutility of Labor We now maintain wage homogeneity, but disutility of labor v is distributed between individuals according to CDF $G_t^v(v)$. First, each individual i is now characterized by their type $v(i)$. Now, the household maximizes:

$$\max_{\{c_{vt},e_{vt}\},A_{t}}\mathbb{E}_{0}\sum_{t=0}^{\infty}\int\left[u(c_{vt})-e_{vt}v_{t}\right]g(v)dv \tag{37}$$

$$\text{s.t. } A_{t}+\int c_{vt}g(v)dv\leq A_{t-1}(1+r_{t-1})+(1-\Xi_{t})y_{t}\int e_{vt}g(v)dv+T_{t} \tag{38}$$

First, we define the reservation wedge for each individual characterized by their type $v(i)$:

$$1-\xi^*_{it} = \frac{v_{it}}{\overline{y}_t\overline{\lambda}_t} \tag{39}$$

$$= 1-\xi^*_{vt} \tag{40}$$

Second, aggregate labor supply curve, i.e. distribution of $1-\xi^*_{it}$, will follow directly from $G^v_t(v)$ since consumption and wages are homogeneous. The household head sends off members with $1-\xi^*_{it} < 1-\Xi_t$ to employment, and all others to nonemployment:

$$E_t = F_t(1-\Xi_t) = P\left(1-\xi^*_{it} \leq 1-\Xi_t\right) = P\left(v_{it} \leq \frac{1-\Xi_t}{\overline{y}_t\overline{\lambda}_t}\right) = G^v_t\left(\frac{1-\Xi_t}{\overline{y}_t\overline{\lambda}_t}\right) \tag{41}$$

Alternatively, pointwise optimization would lead to a disutility cutoff rule $v^*_t = (1-\Xi_t)\overline{y}_t\overline{\lambda}_t$: $v_{it} \geq v^*_t$ types work, $v_{it} < v^*_t$ types stay at home.

Third, the elasticity is given by $\left[(1-\Xi_t)g^v_t\left(\frac{1-\Xi_t}{\overline{y}_t\overline{\lambda}_t}\right)\right] / \left[1-G^v_t\left(\frac{1-\Xi_t}{\overline{y}_t\overline{\lambda}_t}\right)\right]$.

MaCurdy (1981) Preferences: Ad-Hoc Constant Frisch Elasticity A common representative household setup (pooled budget constraint and homogeneous wages) applies the familiar isoelastic *intensive*-margin MaCurdy (1981) preferences to the extensive margin:

$$\frac{C_t^{1-\sigma}}{1-\sigma} - \Psi\frac{E_t^{1+1/\eta}}{1+1/\eta} \tag{42}$$

We now *reverse-engineer* a distribution of disutility $G^v_t(v)$ that delivers this labor supply specification. The micro wedge is again given by (39). Suppose v follows a power distribution $G^v_t(v) = \left(\frac{v}{v_{\max}}\right)^{\alpha_v}$ with shape parameter α_v over support $[0, v_{\max}]$. Then, aggregate employment is (building on Section 2, assuming positive nonemployment by all types):

$$E_t = F_t(1-\Xi_t) = P\left(\frac{v_{it}}{\overline{y}_t\overline{\lambda}_t} \leq 1-\Xi_t\right) = G^v_t\left((1-\Xi_t)\overline{y}_t\overline{\lambda}_t\right) = \left(\frac{(1-\Xi_t)\overline{y}_t\overline{\lambda}_t}{v_{\max}}\right)^{\alpha_v} \tag{43}$$

The wedge distribution then too is a power distribution inheriting shape parameter α_v – giving the constant extensive margin Frisch elasticity:

$$\epsilon_{E_t,1-\Xi_t} = \frac{(1-\Xi_t)F_t(1-\Xi_t)}{F_t(1-\Xi_t)} = \frac{(1-\Xi_t)\alpha_v(1-\Xi_t)^{-1}\left(\frac{(1-\Xi_t)\overline{y}_t\overline{\lambda}_t}{v_{\max}}\right)^{\alpha_v}}{\left(\frac{(1-\Xi_t)\overline{y}_t\overline{\lambda}_t}{v_{\max}}\right)^{\alpha_v}} = \alpha_v \tag{44}$$

To show that this household can be written as a representative household with a MaCurdy preference structure, consider a rearrangement the aggregate labor supply curve (43):

$$v_{\max} E_t^{\frac{1}{\alpha_v}} = (1 - \Xi_t)\overline{y}_t \overline{\lambda}_t \tag{45}$$

which is the first order condition of objective function (42) for $\eta = \alpha_v$ and $\Psi = v_{\max}$.[26]

In Figure 6 (b), we plot the density of reservation wedges for a MaCurdy model with potential earnings $\overline{y}$ and marginal utility of consumption $\overline{\lambda}$ are normalized to one, and the Frisch elasticity is 0.32. The maximum micro labor supply disutility is set to $0.607^{-1/0.32}$ to set the equilibrium employment rate at 60.7%.

Heterogeneous (Sticky) Wages and MaCurdy: Gali (2015) The New Keynesian model of Gali (2015) additionally features wage heterogeneity. Individuals are a unit square indexed by $(l, s) \in [0, 1] \times [0, 1]$. l denotes the type of labor, paid wage y_{lt}, which may diverge across types due to wage stickiness. s indexes labor disutility, $s^{1/\eta}$. The household head maximizes:

$$\max_{c_t, \{E_{lt}\}} \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^{t-s} \Big(\frac{c_t^{1-\sigma} - 1}{1 - \sigma} - \Psi \int_0^1 \overbrace{\int_0^{E_{lt}} s^{1/\eta}}^{E_{lt}^{1+1/\eta}/(1+1/\eta)} \, ds dl \Big) \tag{47}$$

$$\text{s.t. } A_t + \int_0^1 c_{lt} dl \le A_{t-1}(1 + r_{t-1}) + (1 - \Xi_t) y_{lt} E_{lt} + T_t \tag{48}$$

where the l-specific employment rate is $E_{lt} = \int_0^1 e_{lt} dl$.

First, we define the micro reservation wedge, characterizing individual i by type sl:

$$1 - \xi^*_{slt} = \frac{\Psi s^{\eta}}{y_{lt} \overline{\lambda}_t} \tag{49}$$

Second, $1 - \xi^*_{slt}$ follows (with *some* nonemployment within each *wage*-type l as in Section 2), a

[26] Alternatively, we can directly derive total disutility of labor $V(E_t)$ from employment rate $E_t \in [0, 1]$, where the head optimally sorts the members by their disutility of labor up until $v = \mu(E_t)$, a threshold defined as the disutility of working of the marginal worker for total employment $E_t = G^v(\mu(E_t)) = \left(\frac{\mu(E_t)}{v_{\max}}\right)^{\alpha_v}$, which gives quantile function $\mu(E_t) = v_{\max} E_t^{1/\alpha_v}$, and hence:

$$V(E_t) = \int_0^{\mu(E_t)} v dG_t^v(v) = \frac{\alpha_v}{v_{\max}{}^{\alpha_v}} \int_0^{\mu(E_t)} (v)^{\alpha_v} dv = \frac{\alpha_v}{v_{\max}{}^{\alpha_v}} \frac{v^{1+\alpha_v}}{1 + \alpha_v} \Bigg|_0^{\mu(E_t)} = v_{\max} \frac{E_t^{1+1/\alpha_v}}{1 + 1/\alpha_v} \tag{46}$$

which again mirrors MaCurdy utility function (42) for $\eta = \alpha_v$ and $\Psi = \overline{v}$.

power distribution with maximum $\Psi\left(\left(\int_0^1 {y_{lt}}^{\eta} dl\right)^{1/\eta} \overline{\lambda}_t\right)$ and shape parameter η.

$$F_t(1-\Xi_t) = P\left(\frac{\Psi s^{1/\eta}}{y_{lt}\overline{\lambda}_t} \leq 1-\Xi_t\right) = \int_0^1 \left(\frac{(1-\Xi_t)y_{lt}\overline{\lambda}_t}{1/\eta}\right)^{\eta} dl = \left(\frac{(1-\Xi_t)}{\Psi\Big/\left(\left(\int_0^1 y_{lt}^{\eta} dl\right)^{1/\eta}\overline{\lambda}_t\right)}\right)^{\eta} \tag{50}$$

Third, again as in Section 2 the elasticity is again precisely η.[27]

4.2.2 Heterogeneous Agent Models: Atomistic Households Without Risk Sharing

We now move to heterogeneous agent models, where atomistic households make labor supply and consumption decisions with separate budget constraints potentially facing incomplete markets. These class of models can feature heterogeneity in λ_{it}.

A useful classification of heterogeneity is whether it is permanent or transitory.

Permanent Heterogeneity With atomostic agents with separate budget constraints, a mass point of marginal workers endogenously emerges (mirroring intuitions from labor indivisibility with homogeneity (Hansen, 1985)). Specifically, in this setting individuals choose a lifetime fraction of working l_i, or equivalently a probability of working in a given period ϕ_{it} s.t. $\int_{t=0}^{\infty} \phi_{it} = l_i$, as in the time-averaging approach of Ljungqvist and Sargent (2006). Permanent heterogeneity in tastes, endowments or wages affects the average employment probability, yet at each given point in time, these "interior" households are exactly on the margin. This local mass of marginal actors makes up one minus the fraction of households that either never or always work – implying an empirically uninteresting case of the infinite local Frisch elasticity.[28]

[27] Intuitively, the distribution of the reservation wedge is power-distributed with the same parameter within each labor type. As a result, changes in $1-\Xi_t$ elicit the same proportional employment changes from each labor type, and the aggregate employment elasticity inherits that homogeneous elasticity. Our expression holds for $1-\Xi_t$ small enough that $1-\xi^*_{slt} > 1-\Xi_t$ holds for some s within *all* labor types l, i.e. the aggregate wedge must be high enough that *some* workers in each labor type are nonemployed. Otherwise, there is full employment from some labor types, and the labor response from those labor types is zero, so the aggregate Frisch elasticity is lower than η, and the CDF (labor supply curve) is:

$$F_t(1-\Xi_t) = P\left(s \leq \left(\frac{(1-\Xi_t)y_{lt}\overline{\lambda}_t}{\Psi}\right)^{\eta}\right) = \int_0^1 \min\left\{\left(\frac{(1-\Xi_t)y_{lt}\overline{\lambda}_t}{\Psi}\right)^{\eta}, 1\right\} dl \tag{51}$$

mirroring the expression in Equation (13).

[28] To see how permanent heterogeneity can generate trivial reservation wedge dispersion (doing so in continuous time), consider a household (indexed by $i \in [0,1]$) characterized by disutility v_i, initial endowments a_{0i}, and wages w_i (and consumption tastes $u_i(c_{it})$), with stable interest rates $r = \rho$ and no borrowing constraint. So the household's problem is $\max_{c_{it},e_{it},a_{it}} \mathbb{E}_0 \int_{t=0}^{\infty} e^{-\rho t}\left[u_i(c_{it}) - v_i e_{it}\right] dt$ subject to a lifecycle budget constraint $\dot{a}_{it} = (1-\Xi_t)y_i e_{it} + r a_{it} - c_{it} + \mathbb{1}(t=0)\cdot a_{0i} \forall t \Leftrightarrow \int_{t=0}^{\infty} e^{-rt} c_{it} dt = \int_{t=0}^{\infty} e^{-rt}(1-\Xi_t)y_i e_{it} dt + a_{0i}$. First, labor supply is an employment policy e^*_{it} characterized by a constant-over-the-lifecycle reservation wedge $1-\xi^*_{it} = \frac{v_i}{\lambda_i y_i} = 1-\xi^*_i$. Second, the distribution of the wedges (labor supply curve) is $F(1-\Xi_t) = \int_i \mathbb{1}[1-\xi^*_i \leq 1-\Xi_t] di$. The constant wedge structure implies that for a given prevailing wedge $1-\Xi_t$, there are three wedge regions. Two inframarginal regions denote workers that do not work even for (small) wedge increases, as well as those that always work even for small wedge declines. The third set is the

We therefore next move to more realistic models with time-varying heterogeneity, starting with stochastic wages below, then moving to deterministically wage-age profile in Section 4.3

Time-Varying Heterogeneity: Stochastic Wages (Huggett, 1993) We now consider the popular case where the heterogeneity between households arises from stochastic productivity. Incomplete financial markets mean that income shocks pass through into budget constraints, and thence into consumption/savings policies, assets, consumption, and λ_{it}. To study this setting through the lens of the reservation wedge framework, we introduce indivisible labor into the Huggett (1993) model as in Chang and Kim (2006, 2007).

There is a continuum of infinitely lived individuals, in discrete time. Assets a_{it} earn or incur interest r_t. An individual chooses consumption c_{it} and indivisible labor supply $e_{it} \in \{0, 1\}$. Potential earnings y_{it} follow an exogenous Markov process. She maximizes separable preferences, subject to budget constraint and borrowing limit $a_{\min} < 0$ (set so that positive consumption is possible for the lowest earner when at the constraint), with discount factor $\beta \leq 1$:

$$\max_{c_{it}, e_{it}, a_{it}} \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left[\frac{c_{it}^{1-\sigma}}{1-\sigma} - \overline{v} e_{it} \right] \tag{52}$$

$$\text{s.t.} \quad a_{i,t+1} = (1 - \Xi_t) y_{it} e_{it} + (1 + r_t) a_{it} - c_{it} \tag{53}$$

$$a_{it} \geq a_{\min} \tag{54}$$

We solve for consumption and labor supply rules, as well as the joint distribution of assets and productivity states, for an exogenous interest rate r.

First, we calculate reservation wedge for each individual, indexed by a and y (since individuals of the same asset and productivity types face the same optimization problem):

$$1 - \xi^*_{ay} = \frac{\overline{v}}{\lambda_{ay} y} \tag{55}$$

Second, we calculate the wedge distribution (CDF) from the joint distribution of assets and productivities, yielding the labor supply curve:

$$F(1 - \Xi) = \sum_{y \in Y} \int_{a_{\min}}^{\infty} \mathbb{1}[1 - \xi^*_{ay} \leq 1 - \Xi] g(a, y) da \tag{56}$$

where $g(a, y)$ is the density of agents with assets a and potential earnings y.

Two-State Potential-Earnings Process We start by describing the economy with a two-level Markov process for potential earnings, jumping from y_1 to $y_2 > y_1$ (y_2 to y_1) with probability λ_{12} (λ_{21}). Our goal here is to convey intuitions, and to illustrate the complexity of aggregate

set of marginal workers, who endogenously are *exactly* indifferent, and hence will *all* drop out of work for small wedge declines, and *all* move into employment for small wedge increases. Hence, if there is a mass point of these marginal individuals at the prevailing wedge, the labor supply curve will exhibit an infinite Frisch elasticity at the extensive margin.

labor supply with only two wage states – and how reservation wedges can unveil and organize the obscure labor supply curve. The parameters are not picked to match any empirical moments, except for an equilibrium employment rate of 60.7% when $1 - \Xi_t = 1$. We plot the distribution of the wedges in Figure 6 Panel (c).

In the model, for both wage levels, $1 - \xi^*_{ay}$ is increasing in assets, since $\lambda_{ay} = c^{*-\sigma}_{ay}$ is decreasing in assets. As expected, $1 - \xi^*_{a,y_2} < 1 - \xi^*_{a,y_1}$ for any given asset level a, since higher wages raise consumption and the opportunity cost of not working. For $1 - \Xi_t = 1$, all high earners work for any asset holdings in the asset grid (i.e. $1 - \xi^*_{a,y_2} < 1 \; \forall a \in [a_{\min}, a_{\max}]$). Low earners work if assets (and consumption) are low, but above an asset threshold $a^*_{y_1}$ s.t. $1 - \xi^*_{a,y_1} = 1$ prefer leisure.

The implied labor supply curve is plotted in Figure 6 Panel (d), and exhibits complex behavior even with only two wage types, due to the asset distribution. When the labor wedge is at $1-\Xi_t = 1$, the marginal worker is a low-wage worker with a relatively high asset level. As $1 - \Xi_t$ falls, low-earners drop out of employment in descending order of their assets holdings, with lower and lower density. At some point, the marginal worker is a low-wage earner with assets at the borrowing limit. Since there is a *mass* of such individuals, the labor supply curve is locally infinitely elastic (echoing a logic in (Hansen, 1985; Rogerson, 1988)) at that point. As $1-\Xi_t$ falls further, all low-wage individuals become nonemployed, and the marginal worker is now a high earner.

Realistic Earnings Process We now apply a realistic 33-state potential-earnings process, following that in Kaplan, Moll, and Violante (2018) (which features only intensive-margin labor supply).[29] The computational details for the full model are again described in Appendix A.2, and the full set of parameters are in Table 5.

We plot the distribution of the wedges in Figure 6 Panel (e). To further illustrate the compositional sources of the reservation wedge distribution, Panel (f) plots the wedge distribution for three particular out of the 33 total values of potential-earnings states. High-potential-earnings workers tend to have lower reservation wedges, as expected, but the states themselves are not completely informative without reference to the Markov process that guides expected earnings, further highlighting the benefit of the wedge as the sufficient statistic.

Overall, in the heterogeneous agent model calibrated to a realistic earnings process, the reservation wedge distribution is widely dispersed. Specifically and as a result, the model generates a *small* local Frisch elasticity. For a 0.01 pertubation, the downward arc elasticity is 0.72 on the high side, but much smaller upwards (0.18). For large pertubations towards 0.10, the elasticities quickly settle in below 0.5. In the model, the equilibrium reservation wedge distribution and hence labor supply curve inherits the joint distribution of λ and y, so that the curve is particularly inelastic if low earnings realizations are offset by asociated high λ values. Next, we therefore aim to assess

[29] The original states are based on a continuous time process, which we transform the transition matrices to discrete time (quarterly frequency) and, without consequences for quantities, normalize the earnings state levels so that the average steady-state earnings are equal to the 2015 U.S. average personal income. The Markov process represents an underlying process modeled as the sum of two independent components $\log y_{it} = \mathrm{y}_{1,it} + \mathrm{y}_{2,it}$, with each component $\mathrm{y}_{j,it}$ evolving according to a "jump-drift" process. Jumps arrive at a Poisson rate λ_j, and trigger new draws of the earnings component from a mean-zero normal distribution. Between jumps, the process drifts toward zero at rate β_j.

the role of the covariance of the two elements of the reservation wedge.

The Role of Incomplete Financial Markets We now decompose these two components in a simple exercise: we shut off the equilibrium heterogeneity in λ by instead ad-hoc setting a homogeneous $\overline{\lambda}_t$ (normalized to generate the same baseline employment rate). This experiments evoke complete markets, where y-contingent claims would neutralize the effects of stochastic productivity on λ, generating a wedge distribution that mimics the representative full-insurance household, since $1 - \xi^*_y = \frac{\overline{v}}{\overline{\lambda} y}$. We plot the resulting wedge-implied labor supply curve reflecting solely heterogeneity in potential earnings y in Figure 6 Panel (g), in the solid line marked by stars where the subset of potential-earning states from the 33 total states are within the range of wedge deviations we plot.

The underlying sparse discrete Markov process renders the full-insurance curve choppy (so we do not plot it in our full Figures 3–5), in particular compared to the full model's incomplete-markets setting plotted also in form of a solid line without markers, where the smooth asset distribution serves to smooth out the wedge distribution. In reality, earnings levels are continuous and the sparse set of earnings levels is chosen for computational reasons, so we additionally plot one arising from *continuous* earnings (for the parametric process which Kaplan, Moll, and Violante (2018) discretize into the 33 states), which naturally smooths out the earnings and hence wedge distribution even with homogeneous λ.[30] This line is plotted as a dashed line, and we also include this benchmark in the overview Figures 3–5.

The comparison highlights the *stabilizing* role of incomplete markets in extensive-margin labor supply in lowering elasticities. The curves with homogeneous λ are dramatically steeper in the low end. This is because λ and y in the incomplete markets setup covary negatively: low productivity agents have high shadow values of income than their better-earning peers. Full insurance eliminates this negative covariance, so the labor supply with full insurance is highly elastic. This intuition is specific to the extensive margin (and hence differs from intensive-margin-only life-cycle intuitions as in Domeij and Floden, 2006; Heathcote, Storesletten, and Violante, 2014).

This exercise illustrates how the reservation wedge framework can offer a specific diagnostic tool to study labor-supply implications also of richer asset market structures, where for example wealthy households can act constrained too, we suspect generating a different joint distribution of λ and y (e.g., as in Kaplan, Violante, and Weidner, 2014; Kaplan, Moll, and Violante, 2018, which do not feature an extensive margin).

[30] To construct this continuous earnings-process-only labor supply curve, we obtain the steady-state distribution of the underlying earnings process described in Footnote 29, by simulating 10,000 realizations to the 2,000th period. The labor supply curve is simply the CDF of this distribution, normalized in log changes around the 60.7% employment rate baseline.

4.3 Intensive and Extensive Margins, and Lifecycle Dynamics: the Rogerson and Wallenius (2008) Model

As in the general intensive-margin case in Section 2.5, permitting hours choices preserves the reservation wedge logic. A leading model with both margins is that by Rogerson and Wallenius (2008) (RW), which also features lifecycle patterns (and whose Frischian behavior Chetty, Guren, Manoli, and Weber, 2012, studied). We discuss our parameterization in Appendix Section A.3, largely following Chetty, Guren, Manoli, and Weber (2012) while targeting a 60.7% employment rate.

The RW overlapping generations economy has a unit mass born at every instant, alive for ages $a \in [0,1]$. Wages w_a are a function of age $a \in [0,1]$, triangular and single-peaked in the original RW setup, generating lifecycle aspects. Choices are consumption, and hours worked at MaCurdy disutility $v(h_a) = \Gamma \frac{h_a^{1+1/\gamma}}{1+1/\gamma}$:

$$\max_{c_a, h_a} \int_{a=0}^{1} e^{-\rho a} \left[u(c_a) - v(h_a) \right] da \tag{57}$$

$$\text{s.t.} \int_{a=0}^{1} e^{-ra} c_a = \int_{0}^{1} e^{-ra} y_a(h_a) da \tag{58}$$

The extensive margin arises from a nonconvexity in form of fixed hours cost: labor hours are productive, and hence are paid, only above hours threshold $\underline{h}$:

$$y_a(h_a) = w_a \max\{h_a - \underline{h}, 0\} \tag{59}$$

Absent this fixed cost, the marginal disutility at $h = 0$ hours is zero, and so everyone works positive hours (provided positive wages) – eliminating the extensive margin.

First, we define the individual-level reservation wedge, here specified for an individual of type age a, implicitly defined as a fixed point, again as in our general job-choice case in Section 2.5. In RW, the discount rate is zero and individuals can save and borrow at zero interest rate, implying $\lambda_a = \overline{\lambda} \forall a$. In what follows in the main text, we normalize $\overline{\lambda}$ to 1, a simplification inconsequential for our Frischian experiments. $h_a^*(1-\Xi)$, the intensive margin choice at age a given wedge $1-\Xi$, is given by $(1-\Xi)w_a = \Gamma {h_a^*}^{1/\gamma}$. We can then solve for the age-specific reservation wedge explicitly (for a given λ, which is homogeneous):

$$1 - \xi_a^* = \frac{v(h_a^*(1-\xi_a^*)}{\lambda y_a(h_a^*(1-\xi_a^*))} = \frac{v\left(\left[\frac{(1-\xi_a)w_a}{\Gamma}\right]^{\gamma}\right)}{w_a\left(\left[\frac{(1-\xi_a)w_a}{\Gamma}\right]^{\gamma} - \underline{h}\right)} = \frac{\Gamma\left(\underline{h}(1/\gamma+1)\right)^{1/\gamma}}{w_a} \tag{60}$$

The only heterogeneous wedge element is the wage: individuals work when the (hourly) wage is above threshold w^*. Also, setting $\underline{h} = 0$ nests the MaCurdy intensive-margin-only setting, with $1 - \xi_a^* = 0$ for all workers and ages, as in our general intensive-margin job choice in Section 2.5.

Second, Figure 6 (h), plots the histogram of the wedge distribution:

$$F(1-\Xi) = P\left(\frac{\Gamma\left(\underline{h}(1/\gamma+1)\right)^{1/\gamma}}{w_a} \leq 1-\Xi\right) = P\left(\frac{1}{w_a} \leq \frac{1-\Xi}{\Gamma\left(\underline{h}(1/\gamma+1)\right)^{1/\gamma}}\right) \tag{61}$$

That is, here the wedge distribution inherits that of $1/w_a$, a feature we discuss in detail below.

Third, we compute the extensive-margin elasticity, numerically approximating the local density using the simulated discretized distribution of $1-\xi_a^*$ (details in Appendix A.3), from which we calculate the Frisch elasticity, which is 2.87 in this particular calibration. In principle, we could obtain the elasticity analytically from the wedge distribution.[31]

The Role of the Intensive Margin Figure 6 (f) additionally plots as a dashed line the curve of a variant in which the hours choice is held fixed at (optimally chosen) pre-experiment levels – hence isolating the extensive margin. The solid line plots the RW extensive-margin labor supply curve that additionally permits intensive margin reoptimization in response to wedge changes. This curve "envelopes" the fixed-hours one: for non-infinitesimal wedge shifts, extensive margin adjustment is attenuated. Intuitively, intensive margin reoptimization raises the return of work. As a result, the flexible-hours employment curve always exceeds the fixed-hours analogue.

The Role of the Wage-Age Profile Our framework clarifies that the particular wage-age profile and the uniform age distribution underlie the shape of the reservation wedge distribution and hence labor supply curve: w_a is piece-wise linear in age (a single-peaked triangle), so the wage distribution is given by the age distribution, as clarified by Equation (61). This suggests the possibility that seemingly unrelated changes in the model structure specifically the productivity-age gradient around the marginal ages may have dramatic effects on the labor supply curve. (For example, if $1/w_a$ were power-distributed, the Rogerson and Wallenius (2008) model would again exhibit a constant Frisch elasticity, an application of our constant elasticity cases from Section 4.) The marginal individuals are just young (or old) enough for their productivity to warrant "entering the labor force" (or "retiring"). Since the age distribution is uniform, the slope of w_a around the cutoff ages (young and old, i.e. "entering the labor force" or "retiring") then determines the extensive-margin Frisch elasticities, with a steeper (flatter) w_a at those points yielding a lower (higher) elasticity of labor supply. At least locally, we therefore suspect that one could engineer a wide range of extensive margin Frisch elasticities by retaining the calibrated productivity profile w_a (hence hitting lifetime calibration targets), but tilting the shape of w_a in an arbitrarily small region around the cutoff ages. By contrast, Chetty, Guren, Manoli, and Weber (2012) use Rogerson and Wallenius (2008) as a macro model example with indivisible labor featuring inherently large labor supply elasticities.

To illustrate this insight, we recalibrate the RW model and now target a lower Frisch elasticity,

[31] Our method complements the construction of the RW Frisch elasticity by Chetty, Guren, Manoli, and Weber (2012), who simulate a small, short-lived one percentage point tax change, which requires repeatedly solving the model for each generation, may include non-Frischian features, and only isolates one arc elasticity.

by allowing a higher level of peak lifetime productivity and a steeper slope of the wage-age productivity gradient. The parameter choices and targets are in Table 5, and we plot the labor supply curves of both calibrations in Figure 6. Under this paramaterization, the density around 1.0 is lower, and so the local elasticity falls. Quantitatively, the calibration implies a local Frisch elasticity (using an arc from 0.995 to 1.005) of only 1.6 – nearly half of the baseline 2.9 elasticity. More flexible non-linear functional forms of the wage-age gradient would likely deliver even lower Frisch elasticities.

5 Potential Business Cycle Implications of the Empirical Curve

No existing model matched the *global* empirical curve. We now take the empirical curve at face value, and retroengineer a model to *precisely* match the empirical curve. Our example draws on a representative household full-insurance setting with heterogeneous disutility of labor. We then assess the performance of this model to explain labor market behavior over U.S. business cycles by conducting a labor wedge analysis (Hall, 1997; Mulligan, 2002; Chari, Kehoe, and McGrattan, 2007; Shimer, 2009).

5.1 One Model Perfectly Matching the Empirical Curve

Broadly, to calibrate a given model's implied wedge distribution to match the empirical target, requires inverting the that of the model-specific heterogeneity sources. The easiest case features a single dimension of heterogeneity among the wedge-relevant components λ, y and v. Specificially, we discuss the case of a representative household whose members are heterogeneous in labor disutility and face homogeneous wages. Disutility of labor v is distributed according to CDF $G_t^v(v)$. As in Section 4.2.1, the household maximizes:

$$\max_{\overline{c}_t,\{e_{vt}\},A_t} \mathbb{E}_0 \sum_{t=0}^{\infty} \left[u(\overline{c}_t) - \int e_{vt} v dG_t^v(v) \right]$$
$$\text{s.t. } A_t + \overline{c}_t \leq A_{t-1}(1+r_{t-1}) + (1-\Xi_t) y_t \int e_{vt} dG_t^v(v) + T_t.$$

The empirical wedge, $1-\hat{\xi}_{vt}$, corresponds to the theoretical wedge of type v as follows:

$$1-\hat{\xi}_{vt} = \frac{1-\xi_{vt}}{1-\Xi_t} = \frac{v}{\left[(1-\Xi_t)\overline{y}_t\right]\overline{\lambda}_t} \tag{62}$$
$$\Leftrightarrow v = (1-\hat{\xi}_{vt}) \cdot \left[(1-\Xi_t)\overline{y}_t\right]\overline{\lambda}_t, \tag{63}$$

for some calibrated values of $\overline{y}_t$ and $\overline{\lambda}_t$. To match the empirical wedge distribution (here $1-\hat{\xi}_{vt}$), the v distribution corresponds to that of the empirical wedge adjusted by $(1-\Xi_t)\overline{y}_t\overline{\lambda}_t$. Let $\hat{f}(\cdot)$ denote the empirical density distribution of $1-\hat{\xi}_{vt}$. Because the multiplication $(1-\Xi_t)\overline{y}_t\overline{\lambda}_t$ is a positive monotone transformation, the density distribution of v, denoted as $g(v)$, can be written as a function of $\hat{f}(\cdot)$:

$$g(v) = \hat{f}\left(\frac{v}{(1-\Xi_t)\overline{y}_t\overline{\lambda}_t}\right)\frac{1}{(1-\Xi_t)\overline{y}_t\overline{\lambda}_t}. \tag{64}$$

We can thus discipline the theoretical disutility distribution by the empirically recovered wedge distribution for any calibrated values of $\overline{y}_t$ and $\overline{\lambda}_t$.

Specifying Aggregate Labor Supply Disutility $V(E)$ It is convenient to directly write aggregate labor supply disutility in terms of the employment rate E_t as function $V(E)$:

$$V(E) \equiv \int e_v v dG^v(v) = \int_{-\infty}^{\mu(E)} v dG^v(v), \tag{65}$$

where we define $\mu(E) \equiv (G^v)^{-1}(E)$ to be the quantile function of the disutility distribution.

In consequence, this representative household setup can be easily made consistent with any extensive-margin empirical aggregate labor supply – as follows:

$$\max_{\{\overline{c}_t, \boxed{E_t}\}, A_t} \mathbb{E}_0 \sum_{t=0}^{\infty} \left[u(\overline{c}_t) - V(E)\right] \tag{66}$$

$$\text{s.t. } A_t + u(\overline{c}_t) \leq A_{t-1}(1 + r_{t-1}) + (1 - \Xi_t)y_t E_t + T_t. \tag{67}$$

Theoretical Properties of $V(E)$ Aggregate labor supply disutility function $V(E)$ has intuitive and convenient properties. Its slope is the disutility of the marginal worker at the verge of (non-)employment, at a given aggregate employment. Due to optimal rationing, $V'(E) > 0$ – and also convex $V''(E) > 0$, as the marginal worker has higher disutlity of labor than its inframarginal predecessor already at work. Formally, these properties follow from Leibniz's rule, the definition of $\mu(\cdot)$ and assuming smoothness of $G^v(\cdot)$. We can then write $V'(E) = \mu(E)g(\mu(E))\mu'(E) = \mu(E) > 0$ over the support, as $\mu'(E) = \frac{1}{g(\mu(E))}$. It is immediate that $V''(E) = \frac{1}{g(\mu(E))} > 0$ over the support.

Analytical Approximation to $V(E)$**: Fitted Polynomial** We now construct a continuous and differentiable analytical function $V(E)$ by fitting a polynomial to the empirical curve. This procedures smooths out and interpolates the discrete empirical distribution to permit fine-grained labor supply levels in the model. Our procedure ultimately approximates the inverse empirical CDF of the reservation wedges. We start by exploiting the aforementioned property of $V(E)$ that its derivative — $V'(E) = \mu(E) = v$ – is the disutility of the marginal person at a given E – hence corresponding to the empirical wedge $1 - \hat{\xi}$ (times a homogeneous factor $\overline{\lambda}(1 - \Xi)$). We then apply a polynomial approximation to $V'(E) = v$ (rather than $V(E)$ directly) over the support of E.[32] We then analytically (anti-)differentiate the polynomial to recover $V''(E)$ and $V(E)$. We use a eighth-degree

[32]Fitting $V'(E)$ rather than $V(E)$ (e.g., through taking conditional expectations of v by E in the data) is appealing because $V(E)$ would nature be smooth and easily fitted, but its curvature determines elasticities, making $V'(E)$ a more informative target for our purposes.

polynomial approximation to the inverse empirical CDF of the disutility distribution (corresponding to employment rate E), weighting to capture local curvatures and global asymmetries. We constrain the first derivative of the polynomial to be positive over the support $E \in [0, 1]$ to ensure an always-increasing marginal disutility of labor. Details of the polynomial approximation are in Appendix Section C.[33] The fitted coefficients for $V'(E)$ are displayed in Table 6, along with the corresponding antiderivate for $V(E)$ and the derivative $V''(E)$.

In Figure 7 Panel (a), we plot our fitted polynomial approximation (solid continuous line) against the empirically recovered disutilities $V'(E) = v$ (hollow circles. Panel (b) displays the analytical antiderivative against the numerical integral, and finally Panel (c) confirms that the second derivative of $V(E)$ is positive over the support.

Naturally, the curve fitting can in principle be done two directions: first – which is our choice –, we fit the extensive-margin MRS analogue to the employment rate, namely by fitting wedge levels to the CDF. Economically, this procedure minimizes the error between the model MRS and the empirical wedge at each given employment point. Minimizing errors in the MRS is most suitable for the goal of the labor wedge analysis, which takes a given empirical employment rate and inputs the MRS and which is exactly what we conduct next below in Section 5.2. Moreover, putting a structure on the MRS as a function of the employment rate is the only way to provide a functional form for $V(E)$. A second option would be to fit the employment rate as a function of the wedge, hence providing a reduced-form labor supply curve. (To our knowledge is no feasible existing way to conduct a total least square fitting to a polynomial that would provide a compromise of minimizing errors on both axes.) Fortunately, our reverse implementation successfully closley matches the labor supply curve as well, in particular with respect to the arc elasticities.

We included the associated fitted line in form of dashed line as labor supply curves in Figures 3 and 4, along with the associated arc elasticities in Figure 5.

5.2 Application: The Cyclical Labor Wedge Revisited

We illustrate the macroeconomic implications of the empirical labor supply curve by comparing its performance to a benchmark business cycle model with standard constant-elasticity labor supply specifications. Our performance measure is the labor wedge (Chari, Kehoe, and McGrattan, 2007; Shimer, 2009), the tax-like gap between the marginal product of labor and the imputed marginal rate of substitution, going from a frictionless general equilibrium with representative agents.

Figure 8 presents results as time series and binned scatter plot for U.S. business cycles, based on quarterly data, with all time series seasonally adjusted and detrended using an HP filter with a smoothing parameter of 1,600.[34]

[33] We select the polynomial degree by informal visual experimentation. The weighting is performed through a weighted constrained polynomial regression of disutility v on polynomials of the employment rate (or the quantiles of each associated v). The weight is based on wedge deviation around the baseline wedge (and hence employment rate) of the form $\omega = [\left|(1-\tau) - 1\right| + 0.01]^{-2}$, hence assigning more weight to local wedge (and hence employment) deviations e.g. relevant to business cycle fluctuations. We constrain the polynomials so that the disutility function is convex; that is, $V''(E) > 0$.

[34] We use are real personal consumption experience per capita (FRED series A794RX0Q048SBEA), the employment to

Representative Household Disutility We posit separable balanced growth preferences for the representative household, with log consumption utility:

$$\ln C_t - V(E_t). \tag{68}$$

We consider three variants for the disutility of labor term $V(E_t)$. The first two are isoelastic curves $\Gamma E_t^{1+1/\eta}/(1+1/\eta)$, such that η denotes the constant Frisch elasticity, for $\eta \in \{0.32, 2.5\}$. Our third variant constructs $V(E_t)$ to perfectly match the empirical curve as described in the previous section. Given that we only measure the labor supply curve at one point in time (in 2019) and hence around a particular prevailing employment rate, we center the model employment rate in the data-consistent $V(E)$ around a slow-moving trend (from an HP-filter with a smoothing parameter of 1,600 given the quarterly frequency our employment rate time series), hence assuming that the shape of the curve around the trend employment rate is stable across the decades.

Fluctuations in the Marginal Disutility of Labor Figure 8 Panels (a) and (b) present the detrended log deviations of $V'(E_t)$, the employment disutility of the marginal worker. Since aggregate employment fluctuations have small amplitudes, this time series traces out the region where the empirical supply curve exhibits *high local* elasticities (see Figure 3). As a result, at business cycle frequencies, the empirically consistent $V'(E)$ resembles high isoelasticity benchmark.

The Labor Market Wedge A useful summary measure of labor market disequilibrium is the labor wedge, a time-varying tax-like gap between the MPL and the MRS:

$$(1 - T_t)F_L(L_t, K_{t-1}) = \frac{-U_L(C_t, E_t)}{U_C(C_t, L_t)} \tag{69}$$

The benchmark, frictionless representative-agent spot labor market equilibrium, would fulfill this equality with a constant zero wedge throughout the cycle. Any deviations in form of a nonzero labor wedge, reflect omitted frictions, taxes, model misspecification or measurement error (Chari, Kehoe, and McGrattan, 2007; Shimer, 2009).

The labor wedge exercise imposes functional forms for the utility and production functions, and then feeds in empirical time series for C_t, E_t and MPL_t, to then back out the time series of the labor wedge $(1 - T_t)$ that leads condition (69) to hold with equality at each point. We follow Shimer (2009) in picking a Cobb-Douglas production function. The MPL time series then, once logged and HP-filtered, inherits that of average real output per hour. (We obtain similar wedges with average real output per worker rather than hour.)

We plot the labor wedge time series in Figure 8, for each $V(E)$ specification. As is well known, calibrating labor supply to a small Frisch elasticity generates a volatile and procyclical labor wedge, such that recessions are times when the gap between the MRS and the MPL widens. One possibility is that households are off their labor supply curves (Karabarbounis, 2014). Another reason is that

population ratio for all persons aged 15 and over (LREMTTTTUSQ156S), and the nonfarm business sector real output per hour of all persons (OPHNFB). We have obtained similar with real output per person, and with alternative consumption proxies including service flows from durables.

the incidence of the market wedge is on firms (Bils, Klenow, and Malin, 2018; Mui and Schoefer, 2018). Yet the larger Frisch elasticity of 2.5 reduces the amplitude of the wedge series.

Setting $V(E)$ to the empirically consistent labor supply curve generates a low-amplitude wedge series – strikingly similar to the high-isoleasticity case. The binned scatter plots in Figure 8 Panel (b) and (d) illustrate this property. Panels (e) and (f) also present the labor wedge that set λ_t counterfactually to be acyclical – hence purely "Frischian". The amplitudes shrink very little, clarifying that the wedge is largely due to the fluctuations in $V'(E)$ in the MRS rather than λ_t.

Inducing Non-Local Variation In Appendix Figure A4, we replicate Figure 8 but ad-hoc amplify the fluctuations in E_t only entering the $V'(E_t)$, while λ_t and the MPL take the actual E_t time series. Then, the data-consistent non-isolastic labor supply curve finally generates a labor wedge in between the 0.25 and 2.5 isoelasticity benchmarks, particularly moving towards the low elasticity during upswings, but during recessions still tightly hugging the low elasticity case (reflecting the asymmetric arc elasticities discussed in Section 3).

In conclusion, the empirical labor supply curve from our survey of U.S. households, taken at face value, implies smooth labor wedges closer to a high elastic labor supply curve (although if taken to the global context, the isoelastic assumption would, unlike our variable-elasticity curve, not at the same time be capable of rationalizing the relatively small arc elasticities to, e.g., large tax holidays).

6 Conclusion

We close by reiterating that our framework and empirical implementation trace out *desired* spot-market labor supply, i.e. underlying preferences. The reservation wedge framework is decidedly agnostic and prior to potential real-world frictions such as search or wage rigidities, which may detach desired from actual employment allocations. Our paper thereby leaves open the degree to which empirical employment adjustment actually occurs along households' desired labor supply curve (see, e.g., Lucas and Rapping, 1969; Hall, 1980, 2009; Bils, Chang, and Kim, 2012; Schmitt-Grohé and Uribe, 2016; Krusell, Mukoyama, Rogerson, and Sahin, 2017; Mui and Schoefer, 2018; Jäger, Schoefer, and Zweimüller, 2018). In Appendix Section B.2, we compare respondents' *realized* employment outcomes past, present and future (using the panel structure in the surveys and administrative data) with their stated reservation wedges, which determines her *rank in the aggregate labor supply curve*. We find suggestive evidence that in the micro data, realized employment outcomes are far from perfectly correlated with reservation wedges, perhaps suggesting either rationed labor supply due to frictions (or measurement error and imperfect persistence in the wedges). By robustly capturing theoretical and empirical extensive-margin labor supply preferences, the reservation wedge framework may prove a useful handle in a dedicated future study of this related long-standing question in labor and macroeconomics, and a notoriously challenging task to assess empirically.[35]

[35]For analyses of the efficiency of group-level employment cyclicalities and respectively employment adjustment at the separation margin, see Jäger, Schoefer, and Zweimüller (2018) and Bils, Chang, and Kim (2012).

References

Achdou, Yves, Jiequn Han, Jean-Michel Lasry, Pierre-Louis Lions, and Benjamin Moll. 2017. "Income and Wealth Distribution in Macroeconomics: A Continuous-Time Approach." *Working Paper* .

Aguiar, Mark, Erik Hurst, and Loukas Karabarbounis. 2013. "Time Use During the Great Recession." *American Economic Review* 103 (5):1664–96.

Aiyagari, Rao. 1994. "Uninsured Idiosyncratic Risk and Aggregate Saving." *The Quarterly Journal of Economics* 109 (3):659–684.

Alvarez, Fernando and Francesco Lippi. 2014. "Price Setting with Menu Cost for Multiproduct Firms." *Econometrica* 82 (1):89–135.

Antoni, Manfred and Arne Bethmann. 2018. "PASS-ADIAB–Linked Survey and Administrative Data for Research on Unemployment and Poverty." *Jahrbücher für Nationalökonomie und Statistik* .

Attanasio, Orazio, Peter Levell, Hamish Low, and Virginia Sánchez-Marcos. 2018. "Aggregating Elasticities: Intensive and Extensive Margins of Female Labour Supply." *Econometrica* 86 (6):2049–2082.

Beffy, Magali, Richard Blundell, Antoine Bozio, Guy Laroque, and Maxime To. 2018. "Labour Supply and Taxation with Restricted Choices." *Journal of Econometrics* .

Benhabib, Jess, Richard Rogerson, and Randall Wright. 1991. "Homework in Macroeconomics: Household Production and Aggregate Fluctuations." *Journal of Political Economy* 99 (6):1166–1187.

Berger, David and Joseph Vavra. 2015. "Consumption Dynamics During Recessions." *Econometrica* 83 (1):101–154.

Bewley, Truman. 1986. "Stationary Monetary Equilibrium with a Continuum of Independently Fluctuating Consumers." *Contributions to Mathematical Economics in Honor of Gérard Debreu* 79.

Bianchi, Marco, Bjorn Gudmundsson, and Gylfi Zoega. 2001. "Iceland's Natural Experiment in Supply-Side Economics." *American Economic Review* 91 (5):1564–1579.

Bils, Mark, Yongsung Chang, and Sun-Bin Kim. 2012. "Comparative Advantage and Unemployment." *Journal of Monetary Economics* 59 (2):150–165.

Bils, Mark, Peter Klenow, and Benjamin Malin. 2018. "Resurrecting the Role of the Product Market Wedge in Recessions." *American Economic Review* 108 (4-5):1118–46.

Blundell, Richard, Luigi Pistaferri, and Itay Saporta-Eksten. 2016. "Consumption Inequality and Family Labor Supply." *American Economic Review* 106 (2):387–435.

Boppart, Timo and Per Krusell. 2016. “Labor Supply in the Past, Present, and Future: A Balanced-Growth Perspective.” *NBER Working Paper* .

Cairo, Isabel, Shigeru Fujita, and Camilo Morales-Jimenez. 2019. “Elasticities of Labor Supply and Labor Force Participation Flows.” *Working Paper* .

Card, David and Dean Hyslop. 2005. “Estimating the Effects of a Time-Limited Earnings Subsidy for Welfare-Leavers.” *Econometrica* 73 (6):1723–1770.

Chang, Yongsung and Sun-Bin Kim. 2006. “From Individual to Aggregate Labor Supply: A Quantitative Analysis Based on a Heterogeneous Agent Macroeconomy.” *International Economic Review* 47 (1):1–27.

———. 2007. “Heterogeneity and Aggregation: Implications for Labor-Market Fluctuations.” *American Economic Review* 97 (5):1939–1956.

Chari, Varadarajan, Patrick Kehoe, and Ellen McGrattan. 2007. “Business Cycle Accounting.” *Econometrica* 75 (3):781–836.

Chetty, Raj. 2006. “A General Formula for the Optimal Level of Social Insurance.” *Journal of Public Economics* 90 (10-11):1879–1901.

———. 2012. “Bounds on Elasticities with Optimization Frictions: A Synthesis of Micro and Macro Evidence on Labor Supply.” *Econometrica* 80 (3):969–1018.

Chetty, Raj, Adam Guren, Day Manoli, and Andrea Weber. 2012. “Does Indivisible Labor Explain the Difference between Micro and Macro Elasticities? A Meta-Analysis of Extensive Margin Elasticities.” *NBER Macroeconomics Annual 2012* .

Chodorow-Reich, Gabriel and Loukas Karabarbounis. 2016. “The Cyclicality of the Opportunity Cost of Employment.” *Journal of Political Economy* 124 (6):1563–1618.

Cogan, John. 1981. “Fixed Costs and Labor Supply.” *Econometrica* :945–963.

Debortoli, Davide and Jordi Galí. 2017. “Monetary Policy with Heterogeneous Agents: Insights from TANK Models.” *Working Paper* .

DellaVigna, Stefano, Attila Lindner, Balázs Reizer, and Johannes Schmieder. 2017. “Reference-Dependent Job Search: Evidence from Hungary.” *The Quarterly Journal of Economics* 132 (4):1969–2018.

Domeij, David and Martin Floden. 2006. “The Labor-Supply Elasticity and Borrowing Constraints: Why Estimates are Biased.” *Review of Economic dynamics* 9 (2):242–262.

Flinn, Christopher and James Heckman. 1983. “Are Unemployment and Out of the Labor Force Behaviorally Distinct Labor Force States?” *Journal of Labor Economics* 1 (1):28–42.

Gali, Jordi. 2015. *Monetary Policy, Inflation, and the Business Cycle*. Princeton University Press.

Gourio, François and Pierre-Alexandre Noual. 2009. "The Marginal Worker and the Aggregate Elasticity of Labor Supply." *Boston University Dept. of Economics Working Papers Series* .

Hall, Robert. 1980. "Labor Supply and Aggregate Fluctuations." In *Carnegie-Rochester Conference Series on Public Policy*, vol. 12. Elsevier, 7–33.

———. 1997. "Macroeconomic Fluctuations and the Allocation of Time." *Journal of Labor Economics* 15 (1, Part 2):S223–S250.

———. 2009. "Reconciling Cyclical Movements in the Marginal Value of Time and the Marginal Product of Labor." *Journal of Political Economy* 117 (2):281–323.

Hall, Robert and Andreas Mueller. 2018. "Wage Dispersion and Search Behavior: The Importance of Nonwage Job Values." *Journal of Political Economy* 126 (4):1594–1637.

Hansen, Gary. 1985. "Indivisible Labor and the Business Cycle." *Journal of Monetary Economics* 16 (3):309 – 327.

Heathcote, Jonathan, Kjetil Storesletten, and Giovanni Violante. 2014. "Consumption and Labor Supply with Partial Insurance: An Analytical Framework." *American Economic Review* 104 (7):2075–2126.

Heckman, James and Thomas MaCurdy. 1980. "A Life Cycle Model of Female Labour Supply." *The Review of Economic Studies* 47 (1):47–74.

Huggett, Mark. 1993. "The Risk-Free Rate in Heterogeneous-Agent Incomplete-Insurance Economies." *Journal of Economic Dynamics and Control* 17.

Imai, Susumu and Michael Keane. 2004. "Intertemporal Labor Supply and Human Capital Accumulation." *International Economic Review* 45 (2):601–641.

Jäger, Simon, Benjamin Schoefer, and Josef Zweimüller. 2018. "Marginal Jobs and Job Surplus: A Test of the Efficiency of Separations." *NBER Working Paper* .

Kaplan, Greg, Benjamin Moll, and Giovanni Violante. 2018. "Monetary Policy According to HANK." *American Economic Review* 108 (3):697–743.

Kaplan, Greg, Giovanni Violante, and Justin Weidner. 2014. "The Wealthy Hand-to-Mouth." *Brookings Papers on Economic Activity* 2014 (1):77–138.

Karabarbounis, Loukas. 2014. "The Labor Wedge: MRS vs. MPN." *Review of Economic Dynamics* 17 (2):206 – 223.

Keane, Michael and Richard Rogerson. 2012. "Micro and Macro Labor Supply Elasticities: A Reassessment of Conventional Wisdom." *Journal of Economic Literature* 50 (2):464–76.

———. 2015. “Reconciling Micro and Macro Labor Supply Elasticities: A Structural Perspective.” *Annual Review of Economics* 7 (1):89–117.

Krueger, Alan and Andreas Mueller. 2016. “A Contribution to the Empirics of Reservation Wages.” *American Economic Journal: Economic Policy* 8 (1):142–79.

Krusell, Per, Toshihiko Mukoyama, Richard Rogerson, and Aysegul Sahin. 2017. “Gross Worker Flows over the Business Cycle.” *American Economic Review* 107 (11):3447–3476.

Kudlyak, Marianna. 2014. “The Cyclicality of the User Cost of Labor.” *Journal of Monetary Economics* 68:53–67.

Le Barbanchon, Thomas, Roland Rathelot, and Alexandra Roulet. 2017. “Unemployment Insurance and Reservation Wages: Evidence from Administrative Data.” *Journal of Public Economics* .

Ljungqvist, Lars and Thomas Sargent. 2006. “Do Taxes Explain European Employment? Indivisible Labor, Human Capital, Lotteries, and Savings.” *NBER Macroeconomics Annual* 21:181–246.

———. 2008. “Two Questions about European Unemployment.” *Econometrica* 76 (1):1–29.

Lucas, Robert and Leonard Rapping. 1969. “Real Wages, Employment, and Inflation.” *Journal of Political Economy* :721–754.

MaCurdy, Thomas. 1981. “An Empirical Model of Labor Supply in a Life-Cycle Setting.” *Journal of Political Economy* 89 (6):1059–1085.

Martinez, Isabel, Emmanuel Saez, and Michael Siegenthaler. 2018. “Intertemporal Labor Supply Substitution? Evidence from the Swiss Income Tax Holidays.” *NBER Working Paper* .

Mas, Alexandre and Amanda Pallais. 2017. “Valuing Alternative Work Arrangements.” *American Economic Review* 107 (12):3722–59.

———. 2019. “Labor Supply and the Value of Non-Work Time: Experimental Estimates from the Field.” *American Economic Review: Insights* 1 (1):111–26.

Mortensen, Dale and Christopher Pissarides. 1994. “Job Creation and Job Destruction in the Theory of Unemployment.” *The Review of Economic Studies* 61 (3):397–415.

Mui, Preston and Benjamin Schoefer. 2018. “The Short-Run Aggregate Labor Supply Curve with Long-Term Jobs.” *Working Paper* .

Mulligan, Casey. 2002. “A Century of Labor-Leisure Distortions.” *NBER Working Paper* .

Oi, Walter. 1962. “Labor as a Quasi-Fixed Factor.” *Journal of Political Economy* 70 (6):538–555.

Park, Choonsung. 2017. “Consumption, Reservation Wages, and Aggregate Labor Supply.” *Working Paper* .

Peterman, William. 2016. "Reconciling Micro and Macro Estimates of the Frisch Labor Supply Elasticity." *Economic Inquiry* 54 (1):100–120.

Pistaferri, Luigi. 2003. "Anticipated and unanticipated wage changes, wage risk, and intertemporal labor supply." *Journal of Labor Economics* 21 (3):729–754.

Prescott, Edward. 2004. "Why Do Americans Work So Much More Than Europeans?" *Federal Reserve Bank of Minneapolis Quarterly Review* 28 (1):2–13.

Rimoldini, Lorenzo. 2014. "Weighted Skewness and Kurtosis Unbiased by Sample Size and Gaussian Uncertainties." *Astronomy and Computing* 5:1–8.

Rogerson, Richard. 1988. "Indivisible Labor, Lotteries and Equilibrium." *Journal of Monetary Economics* 21 (1):3–16.

Rogerson, Richard and Johanna Wallenius. 2008. "Micro and Macro Elasticities in a Life Cycle Model With Taxes." *Journal of Economic Theory* 144:2277–2292.

Schmitt-Grohé, Stephanie and Martin Uribe. 2016. "Downward Nominal Wage Rigidity, Currency Pegs, and Involuntary Unemployment." *Journal of Political Economy* 124 (5):1466–1514.

Shimer, Robert. 2009. "Convergence in Macroeconomics: The Labor Wedge." *American Economic Journal: Macroeconomics* 1 (1):280–97.

Sigurdsson, Jósef. 2018. "Labor Supply Responses and Adjustment Frictions: A Tax-Free Year in Iceland." *IIES Working Paper* .

Udell, Madeleine, Karanveer Mohan, David Zeng, Jenny Hong, Steven Diamond, and Stephen Boyd. 2014. "Convex Optimization in Julia." *SC14 Workshop on High Performance Technical Computing in Dynamic Languages* .

Tables

Table 1: Reservation Wedge Distributions: Descriptive Statistics for U.S. Data (Survey) and Calibrated Models

Statistic	**Data**: U.S. Pop (Authors' Survey)	U.S. Pop (Fitted)	Hansen (Indiv. Labor)	MaCurdy (0.32)	MaCurdy (2.5)	Rogerson Wallenius	Heterogeneous Agent
Mean	1.06	1.06	1	1.16	0.87	0.96	1.02
Median	0.95	0.94	1	0.56	0.93	0.94	0.95
25 Pctile.	0.65	0.67	1	0.07	0.70	0.83	0.56
75 Pctile.	1.50	1.42	1	1.95	1.09	1.09	1.30
Pct. < 1	63.1%	63.1%	0%	60.5%	60.7%	60.7%	60.7%
Pct. > 1	36.9%	36.9%	0%	39.5%	39.3%	39.3%	39.3%
Pct. > 2	10.6%	20.99%	0%	24.4%	0.0%	0.0%	4.8%
Variance	0.35	0.34	0	1.80	0.07	0.02	0.25
Skewness	0.42	0.49	-	1.10	-0.73	0.39	0.69
Kurtosis	5.14	-0.87	-	3.00	2.76	-1.01	3.06

Note: The table presents statistics of the reservation wedge distributions for the data (U.S. population survey discussed in Section 3), as well as for the models with an extensive margin of labor supply (presented in the model meta-analysis Section 4). The associated aggregate labor supply curves and elasticities are jointly plotted in Figures 3–5 (aggregate labor supply curves) and additional moments are provided in Table 2. For the survey, mean, variance, skewness, and kurtosis were calculated according to Rimoldini (2014), truncating wedges above 2.0. Moments were also calculated truncated wedges above 2.0 for the polynomial fit to the data.

Table 2: Mass of Marginal Agents and Local Arc Elasticities: Reservation Wedge Distribution Around 1.00

	+/-		+		-	
Agg. L. S. Curve	$\frac{d\text{Emp}}{\text{Pop}} \times 100$	Elasticity	$\frac{d\text{Emp}}{\text{Pop}} \times 100$	Elasticity	$\frac{d\text{Emp}}{\text{Pop}} \times 100$	Elasticity
Panel A: **Wedge Interval: 0.01**						
U.S. **Data**	$3.44^{\#}$	$5.66^{\#}$	2.26	3.72	4.61	7.59
U.S. **Fitted**	2.85 4.69	1.93	3.19	3.75	6.18	
Hansen	100.0	∞	100.0	∞	100.0	∞
MaCurdy (0.32)	0.20	0.32	0.20	0.32	0.20	0.32
MaCurdy (2.5)	1.52	2.50	1.53	2.52	1.51	2.48
Het. Agent	0.25	0.41	0.11	0.18	0.43	0.72
Rog.-Wall.	1.74	2.87	1.73	2.84	1.76	2.90
Panel B: **Wedge Interval: 0.03**						
U.S. **Data**	6.87	3.77	2.31	1.27	5.55	3.05
U.S. **Fitted**	8.97	4.37	3.88	2.13	8.77	4.81
Hansen	100.0	∞	100.0	∞	100.0	∞
MaCurdy (0.32)	0.59	0.32	0.58	0.32	0.59	0.32
MaCurdy (2.5)	4.55	2.50	4.66	2.56	4.45	2.44
Het. Agent	0.75	0.42	0.42	0.23	1.04	0.58
Rog.-Wall.	5.23	2.87	5.01	2.79	5.40	2.96
Panel C: **Wedge Interval: 0.05**						
U.S. **Data**	7.49	2.47	4.11	1.35	14.36	4.73
U.S. **Fitted**	11.3	3.72	5.05	1.66	12.07 3.98	
Hansen	100.0	∞	100.0	∞	100.0	∞
MaCurdy (0.32)	0.98	0.32	0.96	0.32	0.99	0.33
MaCurdy (2.5)	7.59	2.50	7.87	2.59	7.31	2.41
Het. Agent	1.34	0.45	0.93	0.31	1.52	0.51
Rog.-Wall.	8.72	2.87	8.30	2.74	9.18	3.02
Panel D: **Wedge Interval: 0.10**						
U.S. **Data**	18.47	3.04	5.81	0.96	22.35	3.68
U.S. **Fitted**	17.12	2.82	6.91	1.14	20.72	3.41
Hansen	100.0	∞	100.0	∞	100.0	∞
MaCurdy (0.32)	1.96	0.32	1.89	0.31	2.02	0.33
MaCurdy (2.5)	15.18	2.50	16.33	2.69	14.06	2.32
Het. Agent	2.46	0.41	1.39	0.23	2.70	0.45
Rog.-Wall.	17.48	2.88	15.85	2.61	19.37	3.19

Note: The table presents masses and local arc elasticities of the reservation wedge distributions for the data (U.S. population survey discussed in Section 3), as well as for the models with an extensive margin of labor supply (presented in the model meta-analysis Section 4). The associated aggregate labor supply curves and elasticities are jointly plotted in Figures 3–5 (aggregate labor supply curves) and additional statistics are provided in Table 1. For each model economy and the survey, in the left columns the table presents the mass of marginal agents (those with wedge levels around one) for various intervals around one, symmetrically ("+/−", e.g. between 0.995 and 1.005), above one, ("+", e.g., 0.995 and 1.005), and below one ("−", e.g., 0.99 and 1.00) The right columns present the implied local arc elasticities for each interval and economy. Superscript # denotes the approximation for the symmetric 0.01 interval in the survey ("U.S. Data"), where responses were restricted to percentage digits, hence this symmetric 0.01 interval is the average of the asymmetric intervals for this entry only.

Table 3: Covariate Analysis: (Log) Reservation Wedge for U.S. Population (Authors' Survey)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Age	-0.023*	-0.021*	-0.023*	-0.020*	-0.020*	-0.018	-0.018	-0.022
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.016)	(0.016)	(0.015)
Age Sq.	0.000***	0.000***	0.000***	0.000***	0.000***	0.000**	0.000*	0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Female	0.074	0.102	0.080	0.099	0.101	0.061	0.062	0.087
	(0.055)	(0.055)	(0.054)	(0.055)	(0.054)	(0.074)	(0.073)	(0.071)
H.S. Diploma	0.072	0.018	0.079	0.064	0.069	-0.116	-0.108	-0.047
	(0.147)	(0.138)	(0.146)	(0.146)	(0.147)	(0.326)	(0.292)	(0.270)
Some College	-0.142	-0.175	-0.135	-0.134	-0.127	-0.131	-0.121	-0.079
	(0.135)	(0.120)	(0.134)	(0.132)	(0.134)	(0.318)	(0.283)	(0.260)
College or Higher	-0.264	-0.274*	-0.261	-0.273*	-0.255	-0.179	-0.176	-0.169
	(0.137)	(0.123)	(0.136)	(0.138)	(0.138)	(0.317)	(0.284)	(0.261)
Good Health		-0.389***						-0.147
		(0.115)						(0.145)
Partnered			0.019					0.089
			(0.056)					(0.078)
Any kids			-0.101					-0.010
			(0.059)					(0.076)
Assets / HH Income				0.049*				0.060*
				(0.019)				(0.029)
Debts / HH Income				0.010				-0.047
				(0.027)				(0.034)
Net. Assets / HH Income					0.037*		0.057*	
					(0.017)		(0.025)	
0 < C.C. Debt ≤ \$3.5k						-0.017	-0.004	-0.035
						(0.098)	(0.100)	(0.094)
C.C. Debt > \$3.5k						-0.078	-0.026	-0.019
						(0.106)	(0.109)	(0.110)
Liquid Assets under \$1k						0.070	0.136	0.131
						(0.087)	(0.092)	(0.100)
Constant	-0.033	0.266	0.009	-0.107	-0.109	-0.188	-0.206	-0.088
	(0.229)	(0.248)	(0.226)	(0.227)	(0.228)	(0.458)	(0.446)	(0.510)
N	1624	1515	1624	1585	1585	875	867	825
R^2	0.18	0.21	0.19	0.20	0.19	0.25	0.26	0.27

Note: $*$: $p < 0.10$, $**$: $p < 0.05$, $***$: $p < 0.01$. Robust standard errors in parentheses. Construction of reservation wedges, survey and sample are described in Section 3. Also includes a set of region fixed effects (9 regions). *Source:* Authors' questionnaire in NORC Amerispeak Omnibus Survey.

Table 4: Covariate Analysis: (Log) Reservation Wedge for U.S. Population (Authors' Survey)
(Additionally Controlling for Labor Force Status)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Unemployed	0.088	0.062	0.094	0.108	0.108	0.046	0.028	0.036
	(0.062)	(0.074)	(0.063)	(0.064)	(0.064)	(0.124)	(0.122)	(0.138)
OOLF	1.292***	1.272***	1.293***	1.308***	1.309***	1.361***	1.347***	1.353***
	(0.074)	(0.074)	(0.075)	(0.079)	(0.078)	(0.093)	(0.091)	(0.095)
Age / 100	-0.534	-0.494	-0.660	-0.525	-0.522	0.006	-0.050	0.009
	(0.754)	(0.744)	(0.756)	(0.767)	(0.767)	(1.193)	(1.193)	(1.109)
(Age / 100) Sq.	0.599	0.595	0.700	0.489	0.486	0.318	0.293	0.079
	(0.861)	(0.849)	(0.856)	(0.882)	(0.881)	(1.333)	(1.337)	(1.250)
Female	0.004	0.018	0.006	0.008	0.008	0.018	0.018	0.031
	(0.044)	(0.045)	(0.043)	(0.044)	(0.043)	(0.061)	(0.060)	(0.058)
H.S. Diploma	0.113	0.104	0.117	0.152	0.153	-0.019	-0.016	0.008
	(0.119)	(0.119)	(0.119)	(0.123)	(0.123)	(0.253)	(0.236)	(0.237)
Some College	0.035	0.018	0.039	0.065	0.066	-0.066	-0.061	-0.046
	(0.108)	(0.105)	(0.109)	(0.112)	(0.111)	(0.249)	(0.231)	(0.233)
College or Higher	-0.012	-0.021	-0.010	0.007	0.010	-0.048	-0.050	-0.049
	(0.112)	(0.108)	(0.112)	(0.118)	(0.116)	(0.248)	(0.232)	(0.232)
Good Health		-0.131						0.014
		(0.095)						(0.121)
Partnered			0.039					0.032
			(0.045)					(0.064)
Any kids			-0.016					-0.033
			(0.047)					(0.058)
Assets / HH Income				0.029				0.022
				(0.016)				(0.024)
Debts / HH Income				-0.022				-0.102**
				(0.024)				(0.033)
Net. Assets / HH Income					0.028*		0.034	
					(0.014)		(0.020)	
\$ 0 < C.C. Debt ≤ \$3.5k						0.033	0.038	0.012
						(0.083)	(0.084)	(0.079)
C.C. Debt > \$3.5k						0.023	0.052	0.067
						(0.083)	(0.087)	(0.087)
Liquid Assets under \$1k						0.011	0.049	0.077
						(0.073)	(0.077)	(0.079)
Constant	-0.447*	-0.375	-0.439*	-0.459*	-0.459*	-0.453	-0.458	-0.459
	(0.198)	(0.219)	(0.201)	(0.202)	(0.202)	(0.354)	(0.351)	(0.419)
N	1624	1515	1624	1585	1585	875	867	825
R^2	0.47	0.47	0.47	0.47	0.47	0.51	0.51	0.52

Note: $*$: $p < 0.10$, $**$: $p < 0.05$, $***$: $p < 0.01$. The table replicates Table 3 but additionally includes a fixed effect for labor force status (employed, out of the labor force, unemployed) as a control variable in each specification. Robust standard errors in parentheses. Construction of reservation wedges, survey and sample are described in Section 3. Also includes a set of region fixed effects (9 regions). *Source:* Authors' questionnaire in NORC Amerispeak Omnibus Survey.

Table 5: Parameters of Models of Aggregate Labor Supply at the Extensive Margin

Parameter	Symbol	Value (by Variant)	
Panel A: Hansen (Indivisible Labor)			
Ext. Margin Labor supply disutility	$\overline{v}$	1.0	
Potential earnings	$\overline{y}$	1.0	
Marginal utility of consumption	$\overline{\lambda}$	1.0	
Panel B: MaCurdy (Isolesticity)			
		Low Frisch (0.32)	High Frisch (2.50)
CRRA consumption parameter	σ	1.00	"
Potential earnings	$\overline{y}$	1.00	"
Shape parameter of labor disutility dist.	α_v	0.32	2.50
Max. labor disutility	$v_{\max}$	4.759	1.221
Panel C: Heterogeneous Agent Model			
		Toy Model	HANK Earnings Process
Potential-earnings states		$\left[y_1, y_2\right] = \left[0.0797, 0.15\right]$	33-State process from
Transition probabilities		$\left[\lambda_{12}, \lambda_{21}\right] = \left[0.1, 0.2\right]$	Kaplan, Moll, and Violante (2018)
CRRA consumption parameter	γ	2.0	2.0
Interest rate	r	0.03	0.03
Discount rate	β	0.95	0.97
Labor disutility	$\overline{v}$	3.0	2.083×10^{-5}
Unemployment insurance	b	0.06	0.00
Min. assets	$a_{\min}$	-0.02	-1.775
Max. assets	$a_{\max}$	0.75	5,000,000
Panel D: Rogerson-Wallenius			
		Baseline	Low-Frisch Variant
Interest rate	r	0.0	"
CRRA consumption parameter	γ	1.0	"
Labor disutility shifter	α	42.492	40.000
Minimum hours	$\overline{h}$	0.258	0.272
Maximum labor productivity	e_0	1.000	1.112
Slope of labor productivity	e_1	0.851	1.320
Intensive-margin Frisch elasticity	η	0.5	"
Tax rate	t	26.0%	"

Note: The table presents the parameters for the models with an extensive margin of labor supply presented in the model meta-analysis Section 4, generating the calibrated reservation wedge distributions and aggregate labor supply curves plotted in Figures 3–5 (aggregate labor supply curves) and Figure 6 (further details on some wedge distributions).

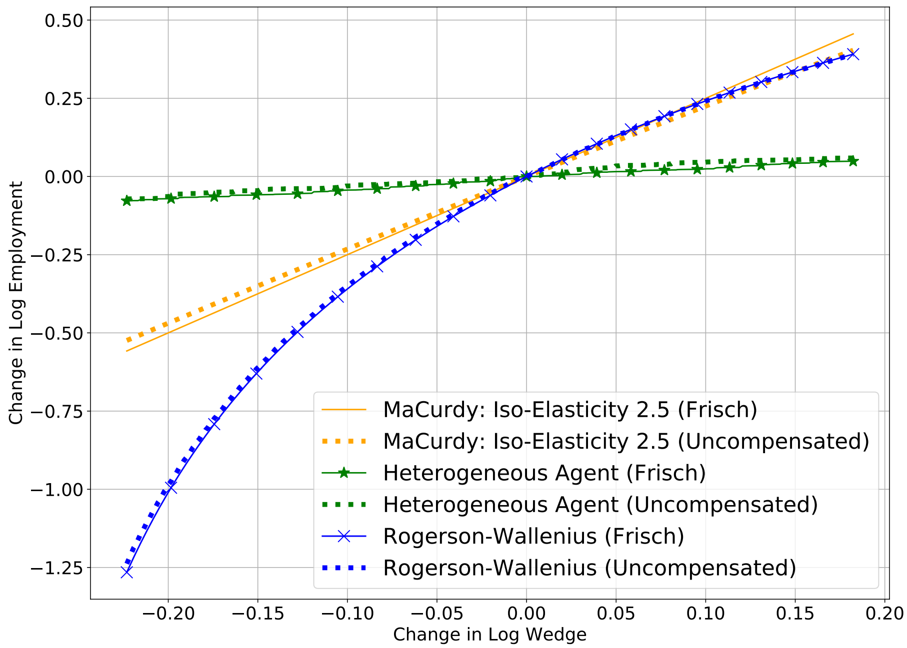
Table 6: Fitted Representative Household Labor Supply Disutility $V(E)$, $V'(E)$ and $V''(E)$ as a Function of the Aggregate Employment Rate $E \in [0,1]$: Coefficients of Polynomial Approximation

Coefficient	$f(E,\beta) = \sum_{i=0}^{\bar{i}} \beta_i^f E^i = \ldots$		
	$V'(E)$ (fitted, $\bar{i} = 7$)	$V(E)$ (analytical from $V'(E)$)	$V''(E)$
β_0^f	$1.03 \cdot 10^{-5}$	0^*	13.88
β_1^f	13.88	$1.03 \cdot 10^{-5}$	-478.41
β_2^f	-239.20	6.94	5889.42
β_3^f	1963.14	-79.74	-32581.88
β_4^f	-8145.47	490.79	93474.10
β_5^f	18694.82	-1629.09	-144600.69
β_6^f	-24100.11	3115.80	114099.61
β_7^f	16299.95	-3442.87	-35816.04
β_8^f	-4477.00	2037.49	
β_9^f		-497.45	

Note: The table reports the coefficients of the polynomial function fitted to match the empirical extensive-margin aggregate labor supply curve measured and discussed in Section 3. The function fitted here corresponds to a representative household's aggregate disutility of employment $V(E)$. We describe the fitting procedure in Section 5 with further details in Appendix C. $V'(E)$ is the eigth-degree polynomial fitted to the empirical labor supply curve, with $E \in [0,1]$ denoting the employment rate. The associated curve is plotted in Figure 7. The microfoundation is a full-insurance representative household, in which household members are heterogeneous in the disutility of working, which acts as a fixed cost due to indivisible labor. As a result $V'(E)$ denotes the disutility of labor of the marginal household member at employment rate E. We obtain $V(E)$ as the analytical antiderivative of $V'(E)$ (with its constant, denoted by *, normalized s.t. $V(0) = 0$). $V''(E)$ is the analytical derivative of $V'(E)$. The properties of the functions in the range of interest $E \in [0,1]$ are $V(E) \geq 0$, $V'(E) > 0$ and $V''(E) > 0$. The corresponding curves and data points are illustrated in Figure 7, and included in Figures 3–5 along with raw empirical data points and the model-implied curves. As in Figure 2, we do not include wedge observations above 2.0, which make up around 10% of our sample (and so our employment rate does not go to 100%).

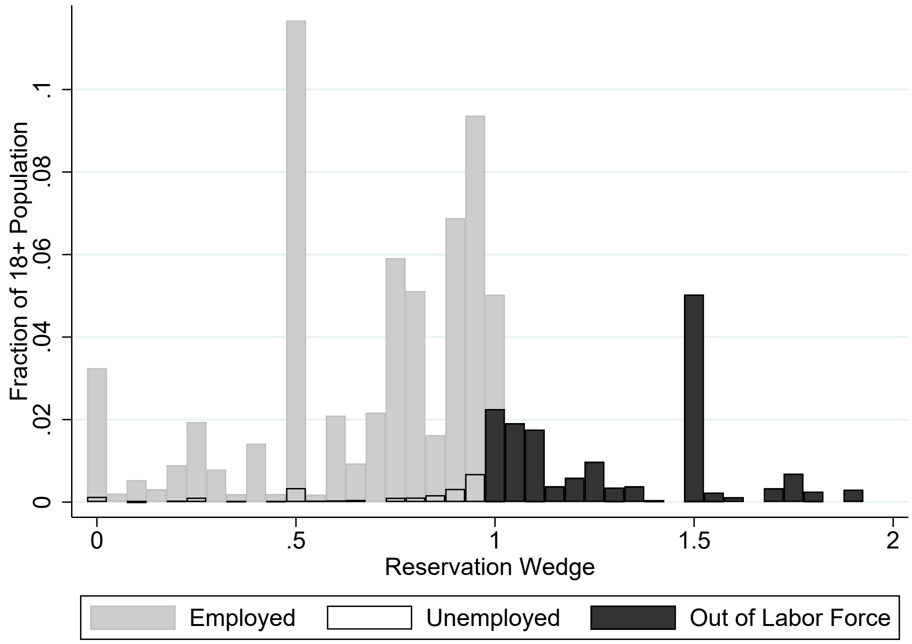
Figures

Figure 1: Frischian vs. Uncompensated Quarter-Long Deviation in the Aggregate Prevailing Wedge: Extensive-Margin Aggregate Labor Supply Responses in Three Calibrated Models

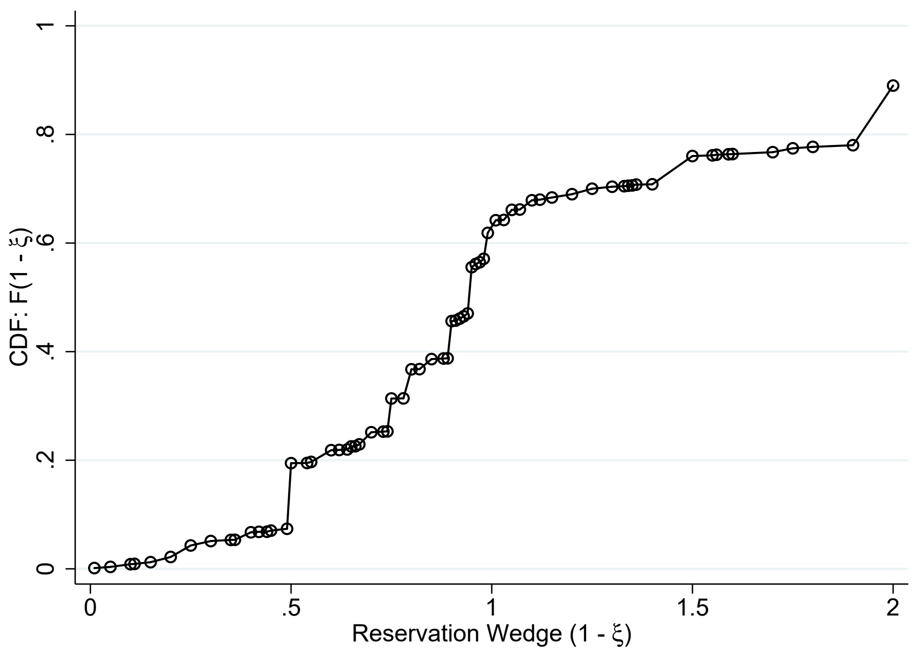


Note: The figure compares aggregate labor supply curves that are purely Frischian (our reservation wedge distributions) and from non-Frischian, uncompensated pertubations in the aggregate prevailing wedxge that are short-lived and last one quarter in each model. The three curves are output from simulating three of the models we discuss in detail in Section 4: a representative household model with an isoelasticity of 2.5, a heterogeneous agent mode with a realistic 33-state earnings process, and the Rorgerson-Wallenius model with lifecycle aspects and an intensive margin hours choice. The specific quantitative experiments are detailed in Appendix A for each model. Model parameters are in Table 5.

Figure 2: Empirical Distribution of Reservation Wedge Proxy in U.S. Population



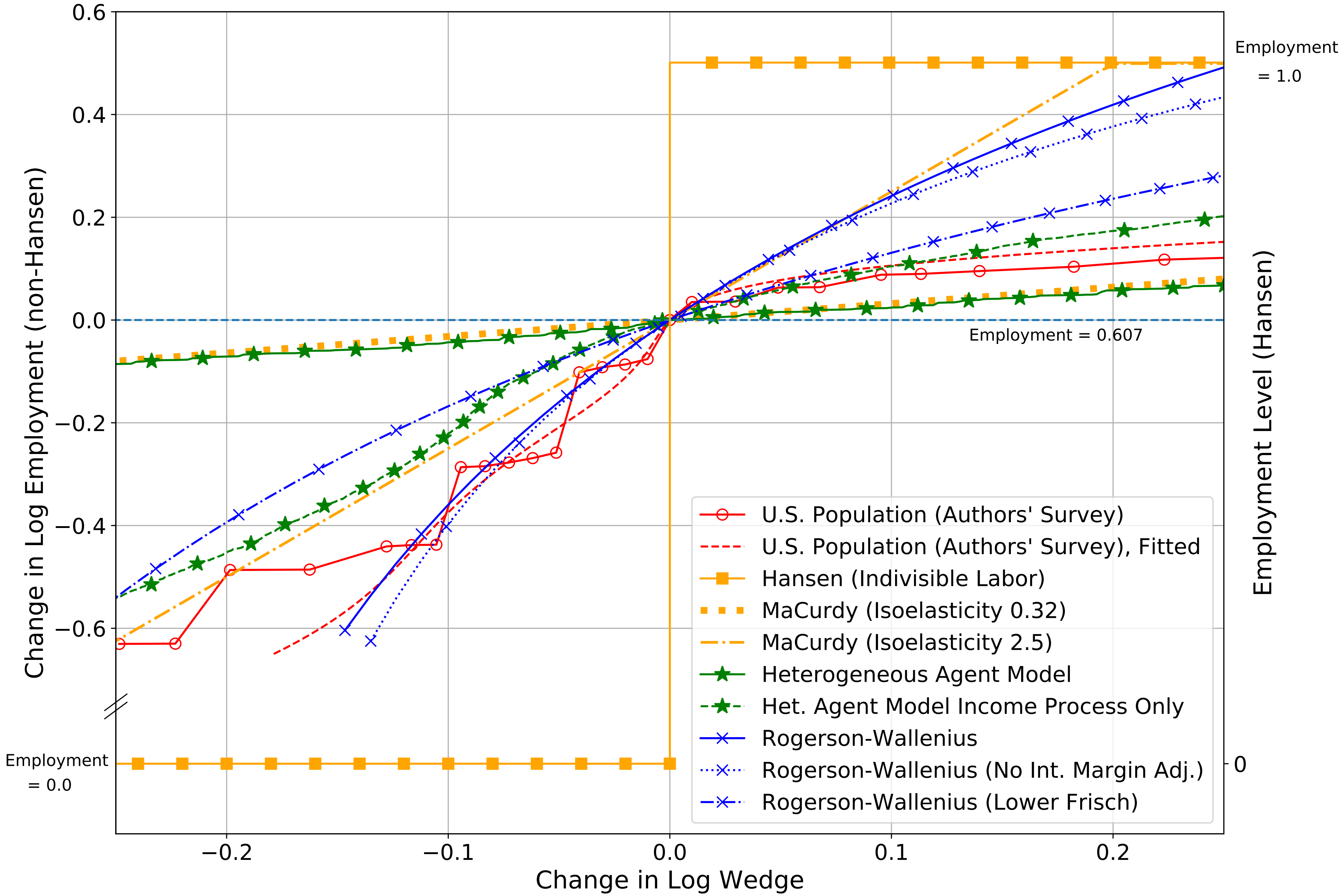
(a) Histogram of the Empirical Reservation Wedge Distribution of the U.S. Population



(b) Cumulative Distribution Function of the Empirical Reservation Wedges (Aggregate Labor Supply Curve of the U.S. Population)

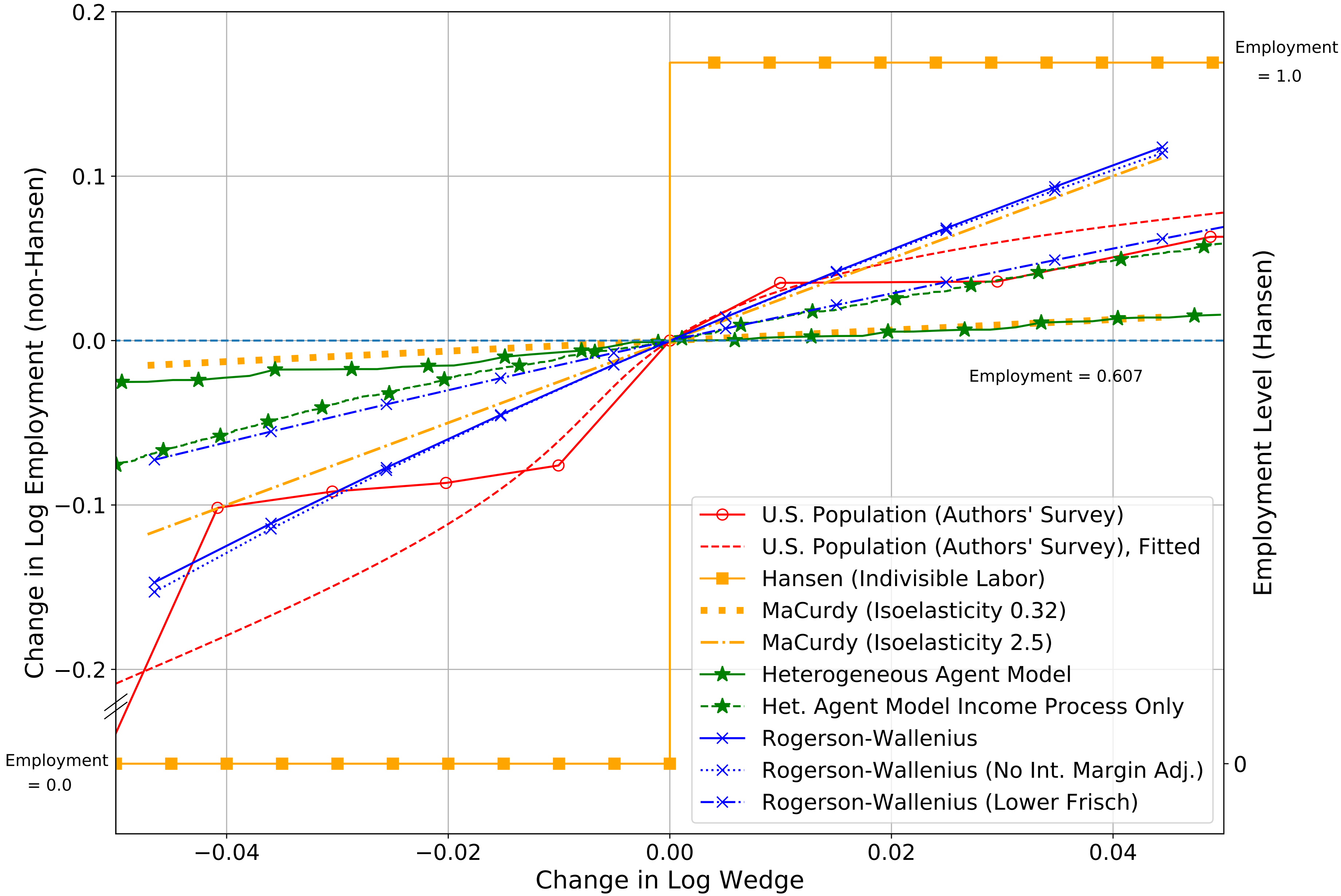
Note: The figure plots the empirical distribution of reservation wedges in a representative sample of the U.S. population. Panel (a) plots the histogram of the reservation wedges, separately by labor force status. Panel (b) plots the population-level cumulative distribution function of the reservation wedges, with hollow circles denoting points at which empirical observations. This CDF is (when evaluating it at a cutting of the prevailing aggregate wedge) the aggregate labor supply curve at the extensive margin. We trucate the distribution at 2.00 (so the CDF does not appear to reach 1). The data source, wedge construction and interpretation of the figure is in Section 3. Additional moments and summary statistics are provided in Tables 1 and 2. Figures 3-4 and 5 plot the logged version of this graph for an elasticity interpretation, and respectively arc elasticities around the unit wedge and the baseline employment rate for this empirical curve (along with model-implied curves). *Source:* Authors' questionnaire in NORC Amerispeak Omnibus Survey.

Figure 3: Comparing the Labor Supply Curves: Model-Implied vs. Data



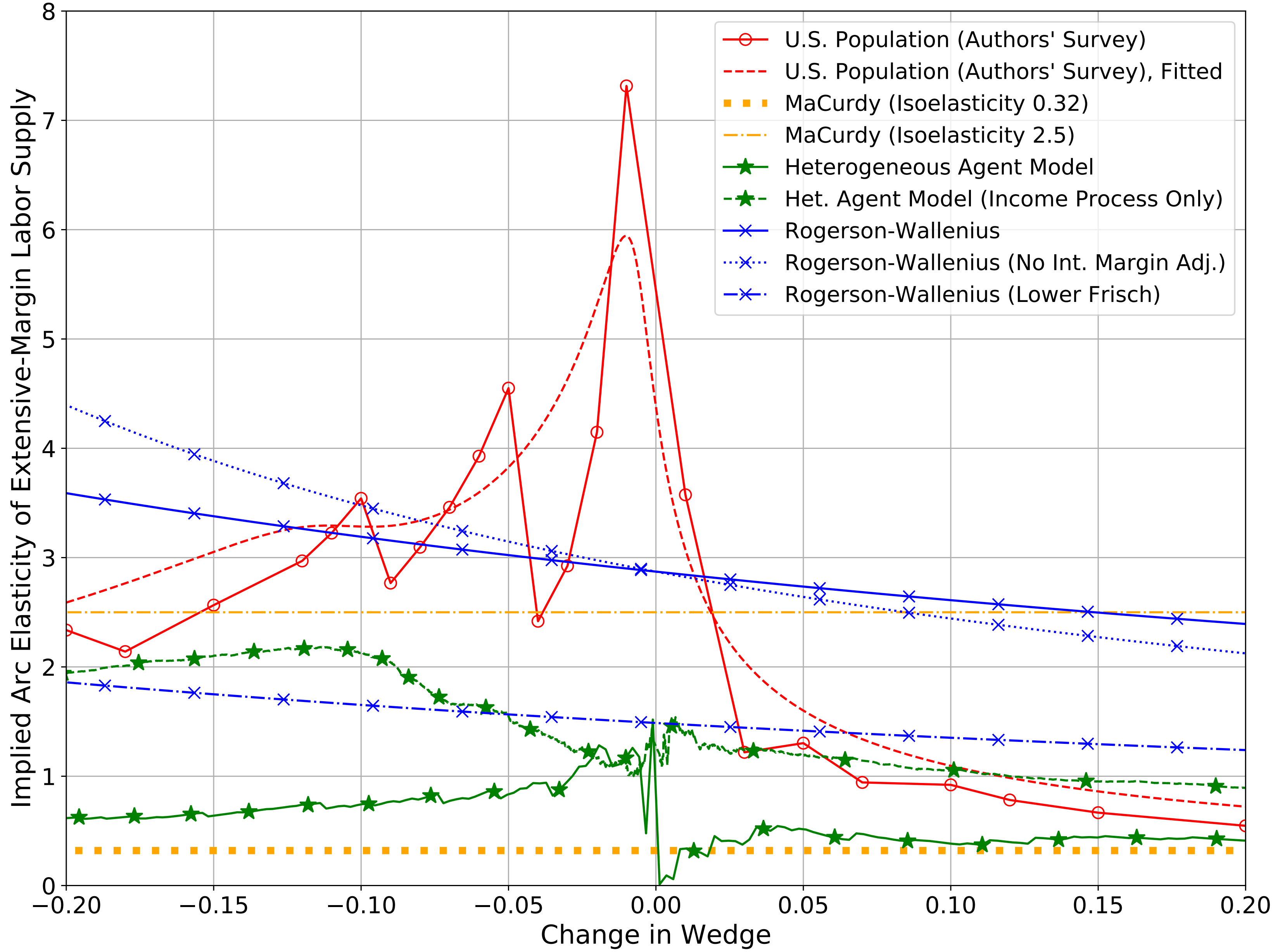
Note: The figure plots the empirical and model-implied short-run aggregate labor supply curves at the extensive margin building on our reservation wedge approach: the log (desired) employment rate against the aggregate prevailing wedge, for range of deviations of the wedge around the baseline level (the x-axis). The empirical labor supply curve is described in Section 3. The curves for a series of macro models with an extensive margin of labor supply are described and calibrated in the meta-analysis in Section 4. All curves go from the same baseline employment level, and from a corresponding baseline wedge normalized to 1.0. The Hansen indivisible labor is plotted on a employment level (rather than log) axis. Figure 4 replicates the above figure but put zooms into smaller wedge deviations to highlight the local properties of the aggregate labor supply curves.

Figure 4: Zoomed In: Comparing the Complete Labor Supply Curves: Model-Implied vs. Data (+/- 0.05 Log Wedge Change)



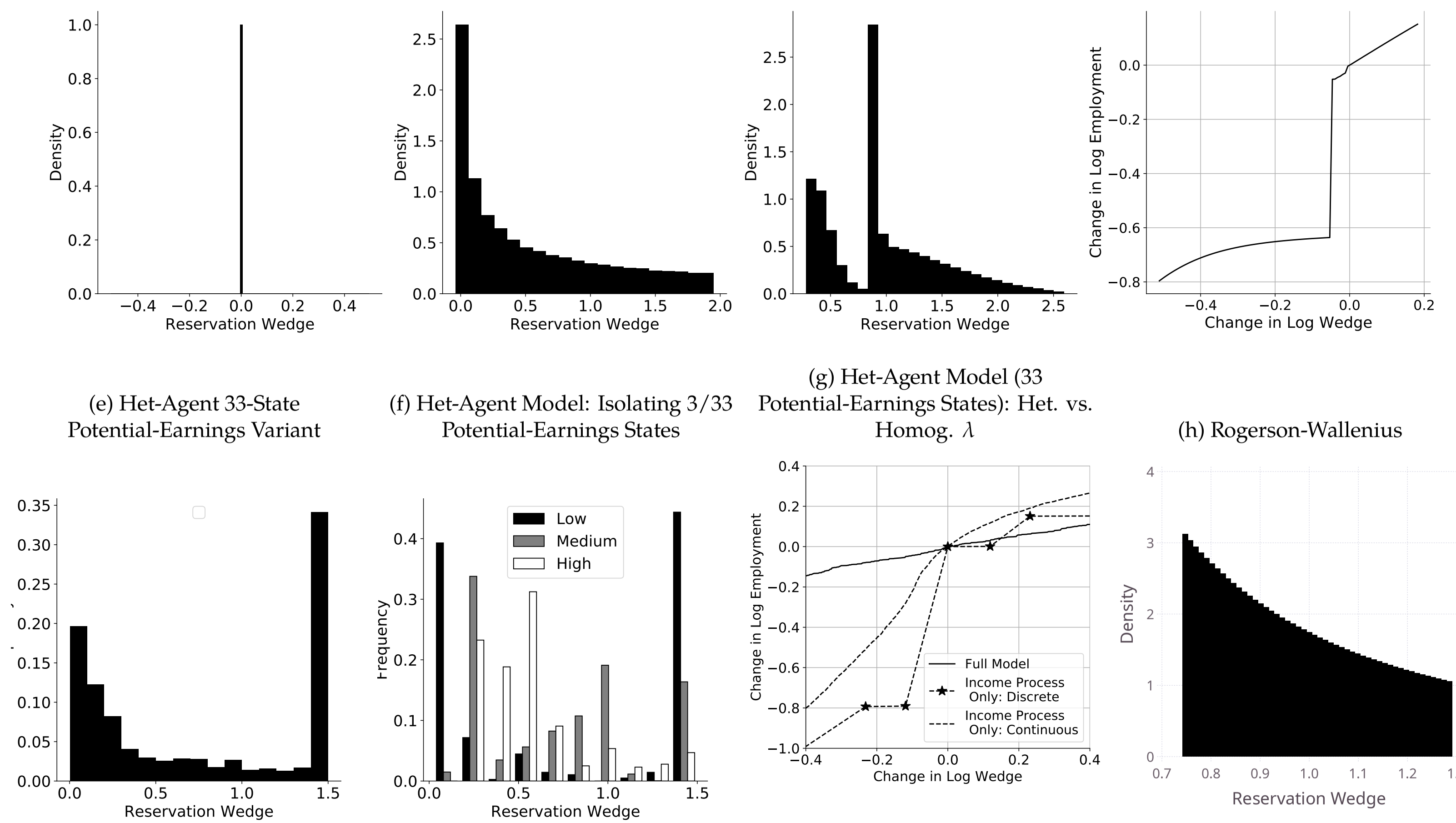
Note: The figure replicates Figure 3 put zooms into smaller wedge deviations to highlight the local properties of the aggregate labor supply curves. As companion Figure 3, the figure plots the empirical and model-implied short-run aggregate labor supply curves at the extensive margin building on our reservation wedge approach: the log (desired) employment rate against the aggregate prevailing wedge, for range of deviations of the wedge around the baseline level (the x-axis). The empirical labor supply curve is described in Section 3. The curves for a series of macro models with an extensive margin of labor supply are described and calibrated in the meta-analysis in Section 4. All curves go from the same baseline employment level, and from a corresponding baseline wedge normalized to 1.0. The Hansen indivisible labor is plotted on a employment level (rather than log) axis.

Figure 5: Arc Elasticities: Model-Implied vs. Data



Note: The figure plots arc elasticities of the employment rate with respect to deviations of the aggregate prevailing wedge $1 - \Xi$, for range of deviations of the wedge around the baseline level (the x-axis). The figure pools these arc elasticities for the empirical labor supply curve (described in Section 3) and for a series of macro models with an extensive margin of labor supply (with the model meta-analysis in Section 4). The arc elasticities are calculated as $\frac{d\text{Emp}}{\text{Emp}} / \frac{d(1-\Xi)}{1-\Xi}$, from the baseline employment level (harmonized across models by calibration) and from a corresponding baseline wedge normalized to 1.0.

Figure 6: Further Details on Model Reservation Wedges Distributions



(a) Hansen: Homogeneity & Rep. HH)

(b) MaCurdy: Heterogeneity w/ 0.32 Isoelasticity & Rep. HH

(c) Het-Agent: 2 Potential-Earnings State Variant, Wedge Histogram

(d) Het-Agent: 2 Potential-Earnings State Variant, Agg. Labor Supply Curve

(e) Het-Agent 33-State Potential-Earnings Variant

(f) Het-Agent Model: Isolating 3/33 Potential-Earnings States

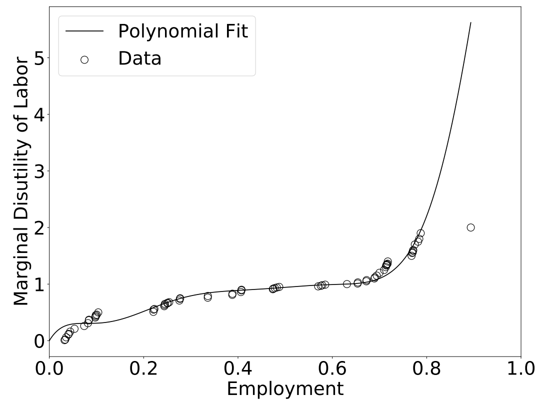
(g) Het-Agent Model (33 Potential-Earnings States): Het. vs. Homog. λ

(h) Rogerson-Wallenius

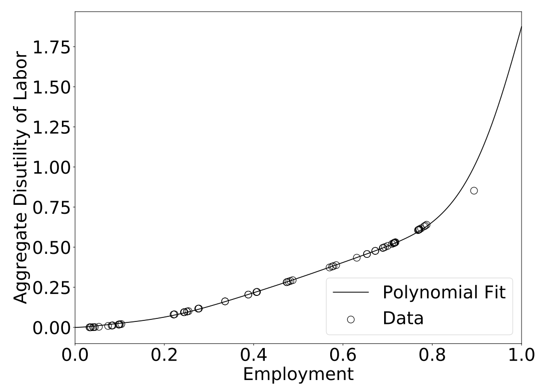
Note: The figure plots additional simulated data from the models reviewed in the meta-analysis in Section 4. Panel (a) plots the histogram of the Hansen (1985) reservation wedges. Panel (b) plots the histogram of the reservation wedges that would emerge in an isoelastic representative household setting with an elasticity of 0.32. Panel (c) plots the reservation wedge histogram from the two potential-earnings states heterogeneous agent model. Panel (d) plots the associated aggregate labor supply curve. Panel (e) plots the histogram of reservation wedges in the 33 potential-earnings states heterogeneous agent model following the realistic earnings process. Panel (f) provides wedges for three earnings states; the Low, Medium, and High potential-earnings levels are 1876.61, 24,489.68, and 117,080.23 respectively. The densities are normalized so that the total density by earnings level sums to one; however, there is 0.395, 0.164, and 0.033 of density for the low, medium, and high earnings levels that have reservation wedges above 1.5 (which we censor). Panel (g) plots the aggregate labor supply curve for the 33-state heterogeneous agent economy but sets the borrowing constraint multiplier λ to be homogeneous (for the original discrete earnings process as well as a richer continuous-state version), thereby isolating the role of the covariance of potential earnings and the shadow value of income in shaping the inelastic labor supply curve. Panel (h) plots the reservation wedge histogram for the calibrated Rogerson and Wallenius (2008) model.

Figure 7: Fitted Representative Household Labor Supply Disutility $V(E)$, $V'(E)$ and $V''(E)$ as a Function of the Employment Rate $E \in [0, 1]$: Visualizing the Fit Between Polynomial Approximation and Data

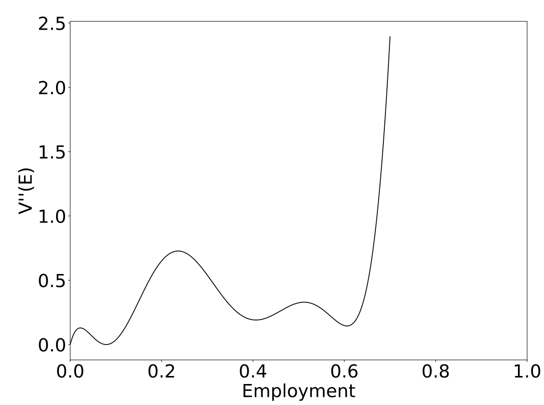
(a) Fit and Target of Marginal Aggregate Disutilty $V'(E) = v$ (Marginal Worker's Micro Disutility)



(b) Aggregate Disutility $V(E)$: Antiderivative of $V'(E)$

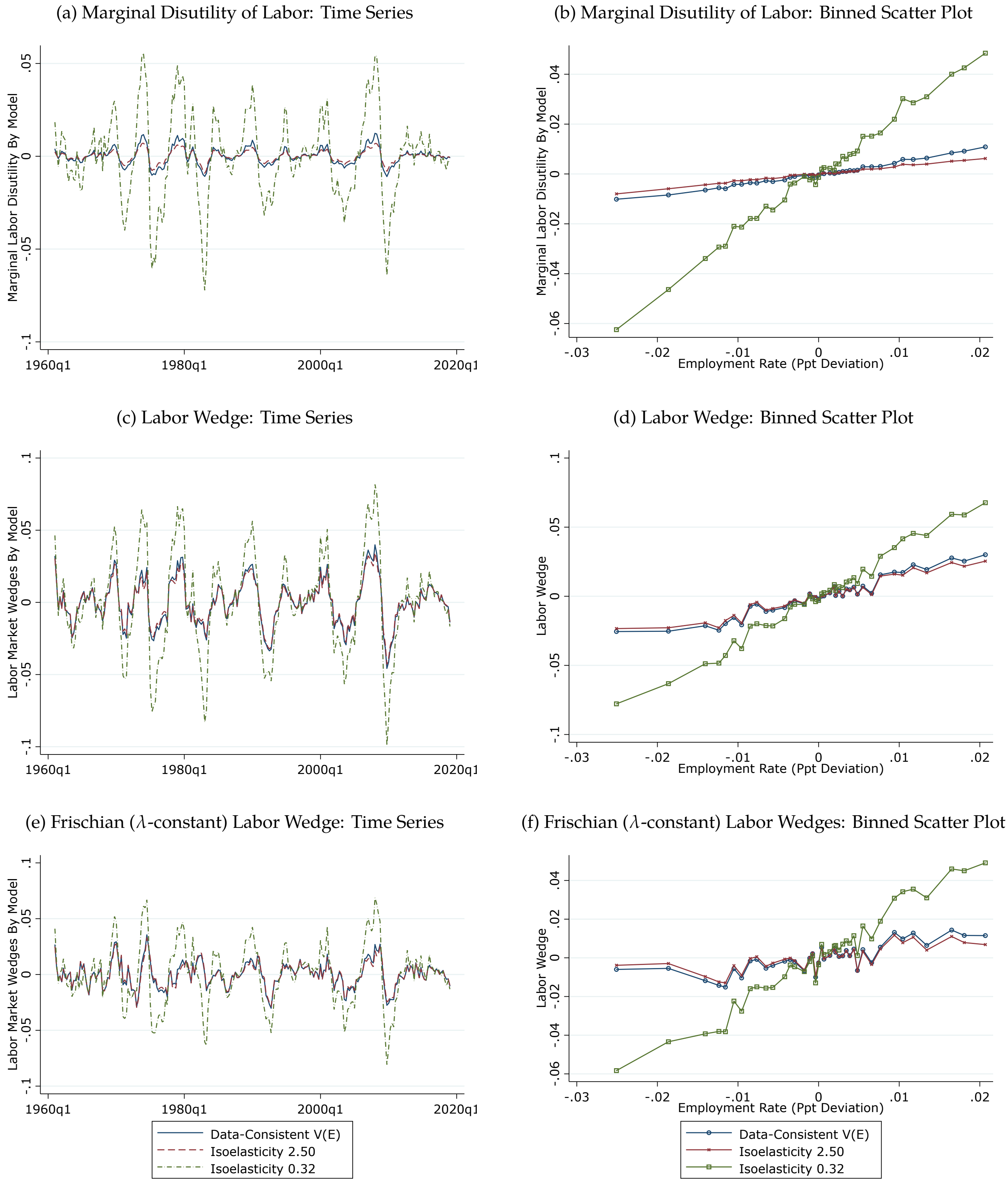


(c) Second Derivative: $V''(E)$



Note: The figures plots the raw data points (hollow circles) along with the the fitted polynomial function (continuous line) fitted to match the empirical extensive-margin aggregate labor supply curve measured and discussed in Section 3. The micro-foundation is a full-insurance representative household with aggregate disutility of employment $V(E)$ capturing household members' heterogeneous disutility of working with indivisible labor. As a result, $V'(E)$ denotes the disutility of labor of the marginal household member at employment rate E. We describe the fitting procedure in Section 5 with further details in Appendix C. $V'(E)$ is the eigth-degree polynomial $f(E, \beta) = \sum_{i=0}^{\bar{i}} \beta_i^f E^i$ fitted to the empirical labor supply curve, with $E \in [0, 1]$ denoting the employment rate. Going from the fitted function for $V'(E)$, we obtain $V(E)$ as the analytical antiderivative (with its constant normalized s.t. $V(0) \approx 0$). $V''(E)$ is the analytical derivative of $V'(E)$. The properties of the functions in the range of interest $E \in [0, 1]$ are $V(E) \geq 0$, $V'(E) > 0$ and $V''(E) > 0$. As in Figure 2, we do not include wedge observations above 2.0, which make up around 10% of our sample (and so our employment rate does not go to 100%). Due to large values towards an employment rate of 100%, we also cut off the plots at different points on the right to maintain readable y-axis ranges. Table 6 reports the coefficients, and the resulting fitted curve is included in Figures 3–5.

Figure 8: Cyclical Implications: Marginal Labor Supply Disutilty and Labor Market Wedges
(Log Deviations From Trend, U.S. Business Cycles, Quarterly Data)



Note: The figure reports the results of the labor wedge analysis described in Section 5.2. Panels (a) (time series) and (b) (binned scatter plot of MRS against the employment rate) plot the model-implied marginal disutilities of labor and implied labor market wedges for U.S. business cycles. Panels (c) and (d) follow the same structure but plot the aggregate labor wedges, the gap between the MPL and the MRS. Panels (e) and (f) finally plot the labor wedges that hold λ constant (by holding consumption constant under separable utility) i.e. only reflect shifts in the marginal disutility of labor $V'(E)$ against the marginal product of labor. Each graph plots these time series for three models of a representative household that only differ in their structure of labor supply in form of the aggregate disutility of employment $V(E)$: Frisch (MaCurdy (1981)) isoelasticities of 0.32 and 2.50, and the data-consistent disutility curve $V(E)$, which we obtain by fitting a polynomial to the empirical reservation wedge distribution as described in Section 5.1 (the empirical curve is discussed in Section 3). Companion Appendix Figure A4 replicates this figure but ad-hoc amplifies the employment fluctuations entering the marginal disutility of labor $V'(E)$ by a factor of 10, to highlight that locally, the curve acts as a high-elasticity ones and at the aggregate business cycle level, unrealistically large employment fluctuations are needed for the curve to reach the lower-elasticity region. All time series are quarterly, and log deviations from trend using an HP filter with smoothing parameter of 1,600.

Appendix of:

The Aggregate Labor Supply Curve at the Extensive Margin: A Reservation Wedge Approach

Preston Mui and Benjamin Schoefer

A Model Details

A.1 The Representative Household Model: A Short-Lived, Uncompensated Shock

Here we describe how we model an uncompensated labor supply response of a representative household with MaCurdy-style convex labor supply disutility and shared consumption.

We consider a household that maximizes

$$\sum_{t=0}^{\infty} \beta^t \frac{C_t^{1-\sigma}}{1-\sigma} - \Psi \frac{L_t^{1-\eta}}{1-\eta} \tag{A1}$$

$$\text{s.t.} \ \sum_{t=0}^{\infty} \frac{1}{1+r} C_t \leq \sum_{t=0}^{\infty} \frac{1}{1+r} (1-\Xi_t) w L_t \tag{A2}$$

so that initial assets are 0 and wages are constant at w. We consider the case were $\beta(1+r)=1$ so that $c_0 = c_1 = \ldots = c$.

In our uncompensated aggregate-wedge shock experiment, we set $1-\Xi_t = 1$ for $t = 0, \ldots, T$, and $1 - \Xi_t = 1$ for $t > T$. The labor response we plot is labor supply in period 0 under these series of wedges.

Denote $\bar{L}$ and $\bar{C}$ as the employment and consumption levels when $1 - \Xi_t = 1$ for all t. The intratemporal substitution condition and the budget constraint imply, respectively:

$$w\bar{C}^{-\sigma} = \Psi \bar{l}^{1/\eta} \tag{A3}$$

$$\bar{C} = w\bar{l} \tag{A4}$$

solving these for $\bar{L}$ delivers $\bar{L} = \left[\frac{w^{1-\sigma}}{\Psi}\right]^{\frac{\eta}{1+\eta\sigma}}$.

Now we turn to the labor choice under a temporary wedge of size $1 - \Xi$ lasting T periods. Let l' and l'' denote labor supply when $1 - \Xi_t = 1 - \Xi$ and $1 - \Xi_t = 1$ respectively. Then, optimal intratemporal labor supply implies

$$wC^{-\sigma} = \Psi L''^{1/\eta} \tag{A5}$$

$$(1-\Xi) w c^{-\sigma} = \Psi L''^{1/\eta} \tag{A6}$$

$$\implies L' = (1-\Xi)^{\eta} L'' \tag{A7}$$

and the budget constraint implies

$$\sum_{t=T+1}^{\infty}\left(\frac{1}{1+r}\right)^t wL'' + \sum_{t=0}^{T}\left(\frac{1}{1+r}\right)^t (1-\Xi)wL' = \sum_{t=T}^{\infty}\left(\frac{1}{1+r}\right)^t C \tag{A8}$$

$$\sum_{t=T+1}^{\infty}\left(\frac{1}{1+r}\right)^t wL'' + \sum_{t=0}^{T}\left(\frac{1}{1+r}\right)^t (1-\Xi)^{1+\eta}wL'' = \frac{1+r}{r}C \tag{A9}$$

$$\frac{1+r}{r}wL'' - \sum_{t=0}^{T}\left(\frac{1}{1+r}\right)^t \left(1-(1-\Xi)^{1+\eta}\right) wL'' = \frac{1+r}{r}C \tag{A10}$$

$$wL'' - \frac{r}{1+r}\sum_{t=0}^{T}\left(\frac{1}{1+r}\right)^t \left(1-(1-\Xi)^{1+\eta}\right) wL'' = C \tag{A11}$$

$$\left[1 - \frac{r}{1+r}\sum_{t=0}^{T}\left(\frac{1}{1+r}\right)^t \left(1-(1-\Xi)^{1+\eta}\right)\right] wL'' = C \tag{A12}$$

Let $m \equiv \left[1 - \frac{r}{1+r}\sum_{t=0}^{T}\left(\frac{1}{1+r}\right)^t \left(1-(1-\Xi)^{1+\eta}\right)\right]$. Combining the above with the intratemporal substitution condition (A6), one can solve for L':

$$L' = \left[(1-\Xi)^{\eta} m^{-\sigma\eta/(1+\sigma\eta)}\right]\left(\frac{w^{1-\sigma}}{\Psi}\right)^{\frac{\eta}{1+\sigma\eta}} = \left[(1-\Xi)^{\eta} m^{-\sigma\eta/(1+\sigma\eta)}\right]\bar{L} \tag{A13}$$

A.2 Computational Details of the Heterogeneous Agent Model with Extensive Margin Labor Supply

Below we describe the model, the potential-earnings process, the solution algorithm, and how we simulate the short-lived uncompensated shock.

A.2.1 The Model

In this section we describe our modification to Huggett (1993) in which individuals make labor supply decisions on the extensive margin only.

Individuals solve

$$\max_{c_{it},e_{it},a_{it}} \mathbb{E}_0 \sum_{t=0}^{\infty}\beta^t\left[\frac{c_{it}^{1-\sigma}}{1-\sigma} - \overline{v}e_{it}\right] \tag{A14}$$

$$\text{s.t.}\quad a_{i,t+1} = (1-\Xi_t)y_{it}e_{it} + b(1-e_{it}) + (1+r_t)a_{it} - c_{it} \tag{A15}$$

$$a_{it} \geq a_{\min} \tag{A16}$$

where $y_{i,t}$ follows the Markov process described in Footnote 29. Households endogenously choose their labor supply eit, which is restricted to 0 or 1. As described in the main text, since individuals within the same asset and productivity levels face the same problem, consumption and labor supply decisions can be written as a function of assets and productivity.

The first-order condition on consumption is, as in the standard case,

$$u_c(c(a,y,t), l(a,y,t)) = V_a(a,y,t) \tag{A17}$$

where V is the value function for someone at asset level a and earnings state y. The optimality condition on labor supply is

$$l(a, w) = \begin{cases} 1 & \text{if } V_a(a, w, t)y_t > \overline{v} \\ 0 & \text{if } V_a(a, w_t)y_t < \overline{v} \end{cases} \tag{A18}$$

A similar optimality condition should be used to solve the agent's problem at the binding constraint $a_{\min}$:

$$l(a_{\min}, y, t) = \begin{cases} 1 & \text{if } \frac{(y+r_t a)^{1-\gamma}}{1-\gamma} - v > \frac{(r_t a)^{1-\gamma}}{1-\gamma} \\ 0 & \text{otherwise} \end{cases} \tag{A19}$$

If $a_{\min} < 0$, this implies that individuals at the borrowing constraint are always employed.

A.2.2 Solution Algorithm

We solve the model with parameters $\sigma = 2$, $r = 0.03$, $\beta = 0.97$, and unemployment insurance $b = 0$. We set the borrowing constraint at $a_{\min} = -z_1 r + 0.001$, so that positive consumption is possible at the lowest productivity and asset levels if the individual works. We choose the labor supply disutility shifter $\bar{v}$ to match the equilibrium employment rate 60.7%.

We use a discrete grid of assets A between $a_{\min}$ and 50000000. We place fifty asset levels equally spaced between $a_{\min}$ and 0, 450 levels between 0 and 1000000, and 500 levels between 1000000 and 5000000. We solve the consumption and labor supply rules using value function iteration:

$$V^{n+1}(a, y) = \max_{a' \in A, l} \{u(yl + (1 + r)a - a') + \beta \sum_{y'} T_{y,y'} V(a', y') \tag{A20}$$

where $T_{y,y'}$ is the transition probability between productivity levels y and y'. Implied consumption is given by $c(a, y) = yl^*(a, y) + (1 + r)a - a'^*(a, y)$, where l^* and a'^* are the solutions to the maximization problem in (A20).

Once we solve for the consumption and labor supply rules, we calculate the equilibrium joint distribution of assets and productivity $g(a, y)$ by solving the system of equations:

$$g(a, y) = \sum_{\tilde{y}} \sum_{\tilde{a} \text{ s.t. } a'^*(a,y)=a} g(\tilde{a}, \tilde{y})$$

With the joint distribution of assets and productivity assets, value functions, and consumption choices, we can solve for the distribution of reservation wedges, and therefore the labor supply curve.

A.2.3 A Short-Lived, Uncompensated Shock

The purpose of this exercise is the simulate the labor supply change of a Heterogeneous Agent economy under a one-period change in the return to working, *uncompensated* (non-Frischian). We assume that labor supply is under partial equilibrium, and simulate the labor supply response to a one-period shift in the prevailing aggregate labor supply wedge.

Consider an individual with assets a and individual productivity level y. That individual faces a temporary labor supply wedge of level $1 - \Xi_t$ during period t, which then returns to a wedge of level 1. Then, that individual solves

$$\max_{c,e} u(c,e) + \beta \sum_{y'} T_{y,y'} V(a', y') \tag{A21}$$

$$\text{s.t. } a' = (1+r)a - c + ey \tag{A22}$$

where

$$u(c,e) = \frac{c^{1-\sigma}}{1-\sigma} - \bar{v}e \tag{A23}$$

and V is the value function from the solution to the equilibrium without a wedge. For a given prevailing labor supply wedge, the solution is easily found by maximizing the utility over a grid of consumption points under employment and non-employment, since the problem is not recursive. We then measure the labor supply response as the difference in the measure of individuals who choose employment under the temporary labor wedge versus the measure of individuals who choose employment in equilibrium.

A.3 The Rogerson and Wallenius (2008) Model

Below we describe the solution of the model, and how we simulate the short-lived uncompensated shock.

The original Rogerson and Wallenius (2008) distribution of the hourly wage w_a (labor efficiency e_a) arises from a uniform age distribution and a triangular wage-age gradient (single-peaked at $a = 1/2$ with $e(1/2) = 1$). We approximate the continuum of generations with 1,000,000 equally-spaced discrete generations, and solve the model following the Technical Appendix of Chetty, Guren, Manoli, and Weber (2012).

To paramaterize the Rogerson and Wallenius (2008) model, we choose the utility function parameters (α, the labor disutility shifter, γ, the labor supply intensive margin elasticity), effective labor supply parameters ($\overline{h}$, the minimum number of hours worked, and e_1, the slope of the wage-age gradient) and the tax rate at which the model equilibrium is calculated.

We set the initial tax rate at 26%, which was the average net tax rate faced by an average single worker in 2017. We set the labor supply intensive margin elasticity to 2.0. From this point, we conduct two paramaterizations. In the first, we choose the remaining three parameters, α, $\overline{h}$, and e_1, to match three equilibrium targets, as in Chetty, Guren, Manoli, and Weber (2012): the employment rate (60.7%, as in the other model exercises), the maximum intensive margin hours choice (0.45), and the ratio of the lowest wage to the highest wage received over the lifecycle (0.5). This paramaterization sets $\alpha = 42.492$, $\overline{h} = 0.258$, and $e_1 = 0.851$.

In the second paramaterization, we also choose the peak of the wage-age profile and target a lower extensive margin Frisch elasticity. This paramaterization sets $\alpha = 40.000$, $\overline{h} = 0.248$, $e_1 = 1.319$, and lifetime peak productivity at 1.110.

For each generation, indexed by a, we calculate hours at each age, h_a^*, and then calculate the wedges using $1 - \xi_a^* = \frac{(1-t)w_a(h_a^* - \overline{h})u'(c_a)}{v(h_a^*)}$. This formulation of the wedge is "normalized" so that the relevant wage is the after-tax wage, and so the indifferent worker is that of the age a such that $1 - \xi_a^* = 1$.

This, combined with the distribution of individuals along the age dimension (uniform), gives the distribution of reservation wedges. We then approximate the local labor supply extensive margin elasticity as $\epsilon_{E_t, 1-\Xi_t}$ by approximating $f(1 - \Xi_t)$ as $\left(\sum_{a=0}^{1} 1[1 - \Xi_t < 1 - \xi_a^* < 1 - \Xi_t + 0.001\right) da$, where da is the distance between generations, and $F_t(1-\Xi_t)$ as $\sum_{a=0}^{1} 1\left[1-\xi_a^* < 1-\Xi_t\right]$.

A.3.1 A Short-Lived, Uncompensated Shock in RW

We simulate the labor supply response of a RW economy under a temporary, short, but non-instantaneous (and therefore non-Frischian) change in the return to working.

We continue to solve the model in continuous time. Note that this does not exactly mirror the question asked in the survey; in our survey, there is a binary decision to take the whole month off or none at all. In continuous time, one could work for part of the month of reduced salary.

In our modeling experiment, we suppose that households are subject to our aggregate prevailing labor wedge $1-\Xi$ for a temporary period of time of duration m. After this interval, the wedge returns to unity. The introduction of the wedge is unanticipated, and once occurring, the households understand that the temporary wedge will last exactly m before returning to unity (an "MIT" shock). Upon realization of the shock, households will re-optimize their planned consumption and labor supply for the remainder of their lives.

Solving for Assets We first need to solve for household assets before the wedge shock. Currently held assets are determined by past earnings, government transfers (which are equal to $t\bar{c}$, where $\bar{c}$, taken as parametric by the household, is the equilibrium consumption level in turn equal to average income and hence $t\bar{c}$ is the average labor income tax and also government rebate) and consumption (c):

$$\int_0^a \left((1-t)w(\tilde{a}) + t\bar{c} - c\right) d\tilde{a}$$

where $w_{\tilde{a}}$ is gross earnings at age $\tilde{a}$. For $\tilde{a} \in [a_{\min}, a_{\max}]$, where $a_{\min}$ and $a_{\max}$ are the work-entry and -exit ages,

$$\begin{aligned}
w_{\tilde{a}} &= e_{\tilde{a}}(h_{\tilde{a}} - \bar{h}) \\
&= e_{\tilde{a}}(h_0 e_0^{-1/\gamma} e_{\tilde{a}}^{1/\gamma} - \bar{h}) \\
&= [h_0 e_0^{-1/\gamma} e_{\tilde{a}}^{1+1/\gamma} - \bar{h} e_{\tilde{a}}] \\
&= \begin{cases} [h_0 e_0^{-1/\gamma}\left(e_0 - 0.5e_1 + e_1\tilde{a}\right)^{1+1/\gamma} - \bar{h}\left(e_0 - 0.5e_1 + e_1\tilde{a}\right)] & \text{if } \tilde{a} < 0.5 \\ [h_0 e_0^{-1/\gamma}\left(e_0 + 0.5e_1 - e_1\tilde{a}\right)^{1+1/\gamma} - \bar{h}\left(e_0 + 0.5e_1 - e_1\tilde{a}\right)] & \text{if } \tilde{a} > 0.5 \end{cases}
\end{aligned}$$

and 0 if $\tilde{a} \notin [a_{\min}, a_{\max}]$ The lifetime net labor income up to age a is:

$$\int_0^a (1-t)w(\tilde{a})d\tilde{a} = \begin{cases} 0 & \text{if } a < a_{\min} \\ (1-t)\left(\frac{h(\tilde{a})}{(2+\frac{1}{\gamma})e_1} - \frac{\bar{h}}{2e_1}\right)e_{\tilde{a}}^2\Big|_{a_{\min}}^{a} & \text{if } a_{\min} \le a < 0.5 \\ (1-t)\left(\frac{h(\tilde{a})}{(2+\frac{1}{\gamma})e_1} - \frac{\bar{h}}{2e_1}\right)e_{\tilde{a}}^2\Big|_{a_{\min}}^{0.5} + (1-t)\left(-\frac{h(\tilde{a})}{(2+(1-t)\frac{1}{\gamma})e_1} + \frac{\bar{h}}{2e_1}\right)e_{\tilde{a}}^2\Big|_{0.5}^{a} & \text{if } 0.5 \le a < a_{\max} \\ (1-t)\left(\frac{h(\tilde{a})}{(2+\frac{1}{\gamma})e_1} - \frac{\bar{h}}{2e_1}\right)e_{\tilde{a}}^2\Big|_{a_{\min}}^{0.5} + (1-t)\left(-\frac{h(\tilde{a})}{(2+(1-t)\frac{1}{\gamma})e_1} + \frac{\bar{h}}{2e_1}\right)e_{\tilde{a}}^2\Big|_{0.5}^{a_{\max}} & \text{if } a \ge a_{\max} \end{cases}$$

Consider an individual of age a. Let m denote the length of the temporary wedge change. One solves for optimal consumption and labor supply by finding the consumption level c_Ξ that balances the income's lifetime budget constraint, subject to (a) their labor income being subjected to a multiplier and (b) the individual adjusting the remainder of their lifetime's labor supply to meet extensive- and intensive-margin inframarginal labor supply optimality conditions. In our experiment, the multiplier will be given by

$$1 - \Xi_{\tilde{a}} = \begin{cases} 1 - \Xi \;\; \text{if } \tilde{a} \in [a, a+m] \\ 1 \;\; \text{if } \tilde{a} > a + m \end{cases}$$

For a proposed consumption level c_{Ξ}, during the ages $\tilde{a} >$, let $h_{\tilde{a},a}$ be the age $\tilde{a} > a$ labor supply choice of an individual that was age a when the temporary labor wedge shift began.

For ages $\tilde{a}$ where the individual works on the extensive margin, intensive margin labor supply implies that

$$\alpha h^{\gamma}_{\tilde{a},a} = (1-t)(1 - \Xi_{\tilde{a})u'(c_{\Xi})e_{\tilde{a}}}$$

As in the standard RW setup, there will be cutoff rules that dictate extensive margin labor supply. Under a temporary $1 - \Xi$ shift, one cannot dictate age cut-offs since the return to working does not follow the same single-peaked shape as the standard model. However, one can determine wedge-productivity cutoffs in $(1 - \Xi_{\tilde{a}})e_{\tilde{a}}$.

At ages $\hat{a}$where the individual is indifferent to extensive margin labor supply (conditional on optimizing on the intensive margin if working), the intensive and extensive margin conditions imply:

$$\begin{aligned} \alpha h^{\gamma}_{\hat{a},a} &= (1-t)(1-\Xi_{\hat{a}})^{i} u'(c_{\Xi})e_{\tilde{a}} \\ \alpha \frac{h^{1+\gamma}_{\hat{a},a}}{1+\gamma} &= (1-t)(1-\Xi_{\hat{a}})^{i} u'(c_{\Xi})e_{\tilde{a}}(h_{\hat{a},a} - \bar{h}) \end{aligned}$$

Combining these two implies

$$h_{\hat{a},a} = \frac{(1+\gamma)}{\gamma}\bar{h}$$

and so

$$\begin{aligned} \alpha\left(\frac{(1+\gamma)}{\gamma}\bar{h}\right)^{\gamma} &= (1-t)(1-\Xi_{\hat{a}})u'(c_{\Xi})e_{\tilde{a}} \\ \implies (1-\Xi_{\hat{a}})e_{\tilde{a}} &= \frac{\alpha\left(\frac{(1+\gamma)}{\gamma}\bar{h}\right)^{\gamma}}{(1-t)u'(c_{\Xi})} \end{aligned}$$

The individual will prefer working over non-working at age
$\tilde{a}$ if $(1-\Xi_{\tilde{a}})e(\tilde{a}) > \alpha\left(\frac{(1+\gamma)}{\gamma}\bar{h}\right)^{\gamma} / \big((1-t)u'(c_{\Xi})\big)$. From this cutoff, one can compute optimal planned extensive margin supply for every age $\tilde{a} > a$. For a proposed candidate for the consumption level, one can then compute the balance of the individual's lifetime budget constraint given both the change in consumption and the lifetime extensive and intensive margin labor supply responses.[36]

[36]To isolate the labor supply response from household preferences, we assume that government transfers and taxes

The solution to the individual's problem is the consumption level c_{Ξ} that balances the individual's lifetime budget constraint. Repeating this for every individual in the RW economy (i.e. repeating this for every age $a \in [0,1]$) delivers the aggregate labor supply response. We measure the labor supply response to this temporary (but non-instantaneous) wedge shift using the change in labor supply upon impact of the wedge.

remain the same. This does mean that the government budget is unbalanced in this exercise.

B Microempirical Analyis: Covariates of Individual-Level Wedges and Employment Outcomes

In Section B.1 we detail the supplementary data sources from household surveys for reservation wedge proxies building on reservation wage data from the unemployed. We use these data for our covariate analysis.

In Section B.2, We assess the micro-empirical relationship between an individual respondent's reservation wedge and her idiosyncratic realized employment outcomes in previous and future periods.

B.1 Supplementary Data: Proxies from Reservation Wage Household Surveys

To enlarge our sample size for a covariate analysis and exploit a larger panel structure, we supplement our custom household survey analysis with data from a set of existing larger surveys limited to unemployed workers and show how reservation wage (rather than wedge) questions can be constructed into wedge proxies.

Additional Proxy: Reservation/Potential Wage Ratios Specifically, the wedge proxy measurable in more standard reservation wage surveys (usually covering the unemployed): the ratio of an individual's *reservation wage* to her (actual or potential) wage. We define an individual's (Frischian) net-of-Ξ reservation wage (earnings) y^r_{it} (for indifference between employment and nonemployment for a short period of time, all else equal), by:

$$(1-\Xi_t)y^r_{it,j(1-\Xi_t)}\lambda_{it} = v_{it,1-\Xi_t} \tag{A24}$$

$$\Leftrightarrow y^r_{it,1-\Xi_t} = \frac{v_{it,1-\Xi_t}}{(1-\Xi_t)\lambda_{it}} \tag{A25}$$

This route requires characterizing the worker's actual or potential earnings $y_{it,1-\Xi_t}$. We can write the reservation wedge as reservation-to-actual/potential-wage ratio, again centered around one and hence mirroring the $(1-\hat{\xi}^*_{it})(1-\Xi_t)$ analogue of the model object as in the aforementioned direct wedge question:

$$\Rightarrow \frac{y^r_{it,1-\Xi_t}}{y_{it,1-\Xi_t}} = \frac{\frac{v_{it,1-\Xi_t}}{(1-\Xi_t)\lambda_{it}}}{y_{it,1-\Xi_t}} \tag{A26}$$

$$= \frac{1-\tilde{\xi}^*_{it}}{1-\Xi_t} \tag{A27}$$

Potential/actual wages for employed workers could be captured by their current wage. For nonemployed respondents, proxies for their potential wage are reported wage expectations for the reservation job, or their last job's wage. There exist surveys that ask about both wages and reservation wages, but almost exclusively the *unemployed* and/or job seekers.

We enlist three surveys for this supplementary analysis: a large administrative snapshot of French unemployment entrants, a large German panel household survey with rich covariates, and a second German survey that we link to administrative employment biographies from social security data.

GSOEP Household Panel Survey The German Socioeconomic Panel (GSOEP) is a long household panel survey. It also elicits reservation wages from unemployed respondents. The reservation wage question is asked at a given survey date. We also have detailed labor market and other characteristics from this rich panel survey. Our potential wage proxy for this data is the last job's wage.

PASS Household Survey The Panel Study Labour Market and Social Security (PASS) of the German Employment Research Institute (IAB) is another household panel survey, designed by IAB to answer questions about the dynamics of households receiving welfare benefits.

Unlike GSOEP, PASS asks respondents about their *expected* wage, providing a potentially more precise potential-wage measure rather than the lagged wages (whereas disutility of labor, preferred hours or the worker's productivity may have changed leading to or following the separation). Moreover, the pairing of wage expectations and reservation wages about a hypothetical future job offer is more likely to hold the particular job constant (e.g. amenities, hours,...).

It also asks the questions of a broader set of households, including employed workers (about their most recent search) . Among the nonemployed, it asks the current searchers (unemployed) as well as those not searching but who state they previously did search. For consistency, we restrict our PASS sample to the nonemployed, but for sample size we pool the unemployed (active searchers) with the out of the labor force (who are still asked about the reservation wages if they ever searched).

PASS–ABIAB Record Linkage to Administrative Matched Employer-Employee Social Security Records We also use a linkage of the PASS survey households to administrative social security records covering pre- and post-interview employment biographies, 1975 through 2014, from IAB (described in detail in Antoni and Bethmann, 2018). The spell data are day-specific, include information on unemployment and other benefit receipts, and therefore permit us to track even small interruptions in employment. We translate the day-specific spell data into monthly frequency, where we count as employment any job spell associated with positive earnings in that month. A limitation is that the IAB data only cover jobs subject to social security payroll taxes, and hence exclude the self-employed and the civil servants (*Beamte*) not subject to these payroll taxes. To limit concerns from such mismeasurement for this analysis in the merged sample, we use the occupation indicator in the PASS survey data and drop all observations where the previous labor market status indicated civil service or self employment. Our employment measure is a snapshot one, where by check the calendar date of the survey, and then forward and revert the year while keeping the month and day fixed.

Administrative Data from UI Agency To benchmark the reservation wedge distributions for unemployed job seekers, have exploit within-worker ratios of micro data collected by the French UI administration (government employment agency) Pôle empoi.[37] The data are binned histograms; we therefore include this data set in the distributional analysis yet cannot provide a covariate analysis. The data cover all UI claimants in France, a context of high UI take-up, and besides eliciting reservation wages at UI claim entry. Our potential wage proxy for this data is the last job's wage (specifically the data set comes as the worker-level reservation to lagged wage ratio).

Proxied Wedge Distributions from the Supplementary Surveys of the Unemployed We present histograms of the empirical reservation wedges from Pole Emploi, PASS and GSOEP in Appendix Figure A2, respectively, and key summary statistics in Appendix Table A1. In both datasets, the distribution of reservation wedges exhibit a spike at one, where the individual's reported reservation wage is equal to the lagged wage (Pole Emploi and GSOEP) and expected wage (PASS).[38]

[37] We thank Le Barbanchon, Rathelot, and Roulet (2017) for sharing the binned data on administrative reservation wage distributions of French UI recipients.

[38] For GSOEP and Pole Empoi, the spike may reflect anchoring in the surveys to the previous wage, or sticky reservation wages as in Krueger and Mueller (2016); DellaVigna, Lindner, Reizer, and Schmieder (2017). In the GSOEP, the mass

B.2 Empirical Relationship Between Micro Labor Supply Outcomes and Wedges

The degree to which desired labor supply is allocative for employment outcomes depends on market structure and potential labor market frictions. One extreme, the Walrasian, frictionless market-clearing model, implies that at the given wage, all workers with positive surplus from employment – with reservation wedges below the prevailing one – will be at work. Away from this benchmark, frictions such as wage rigidity or search frictions can detach the wedge-implied desired labor supply from prevailing employment allocations, due to search frictions, rationing from labor demand, or misperceptions about potential wages.

The reservation wedge measure at the micro level may provide an empirical handle and diagnostic tool for micro-level rationed labor supply, a notoriously challenging task to assess empirically (for analyses of the efficiency of employment adjustment at the group-level cyclical dimension and the separation margin, see respectively Bils, Chang, and Kim, 2012; Jäger, Schoefer, and Zweimüller, 2018).

To investigate the empirical consequences of such rationed labor supply (conversely, the allocative consequences of desired labor supply), we compare respondents' *realized* employment outcomes past, present and future (using the panel structure in the surveys and administrative data) with their stated reservation wedges, which determines her *rank in the aggregate labor supply curve*.

Formally, our empirical design investigates the discrete choice of desired labor supply $e^*_{it} \in \{0, 1\}$ following the wedge cutoff:

$$e^*_{it} = \begin{cases} 0 & \text{if} \quad 1 - \xi^*_{it} > 1 - \Xi_t \\ 1 & \text{if} \quad 1 - \xi^*_{it} \leq 1 - \Xi_t \end{cases} \tag{A28}$$

Specifically, we plot the empirical employment rates $P(e_{it+s}|1 - \xi^*_{it})$ by *continuous* reservation wedges at various horizons s relative to the survey year and for our various surveys. Figure A3 presents the results using the GSOEP (a large and long household panel) and from our survey of U.S. households (where we included forward- and backward-looking employment questions).

Below we show our approximations in three data sets.

U.S. Survey Data In our survey, we ask three variants for study the intertemporal dimension in our cross section of respondents:

1. Thinking back to the last two years, how many months were you not working (not counting vacations)?

2. Consider your future plans and expectations regarding your work situation. How many <u>months</u> out of the next two years do you think you will likely <u>not</u> be working?

3. What do you believe is the probability you will be working in a job exactly <u>two years from now</u>? We are looking for a percentage number. For example, a 50% probability means that it is just as likely that you will be working as not. A 100% probability means that you are sure that

of unemployed workers whose reservation wedge is equal to one accounts for about 6.2% of workers for whom we calculate reservation wedges. By contrast, only 0.2% report a wedge between 0.99 and 1.01 that is not equal to 1. In PASS, the bunching at 1 arises from the structure of the survey question: the survey first asks about the expected wage, and then asks whether or not the worker would also take lower offers. Only for those responding yes will be asked to specify the reservation wage. For Pole Emploi and GSOEP, a significant amount of workers have a reservation wedge above 1. This is likely the consequence of measurement error as we use past way for the potential wage, as unemployed job seekers should have a reservation wedge lower than one (otherwise should not be searching).

you will be working. 0% means that you are sure that you will not be working exactly two years from now. You can give any percentage number between 0% and 100%.

Figure A3 Panels (c) and (d) present the results for the cross-section of the U.S. population from our representative sample. Observations above 1 are out of the labor force, below 1 are unemployed searchers or the employed by construction. Panel (c) presents the raw data, and Panel (d) after residualizing with labor force status fixed effects to remove the mechanical jump at 1 (hence tracing out within-labor-force-status variation). The data reveal a compelling downward-sliping pattern for all groups, validating the measure. However, the slope is far from clear-cut.

Unemployed Job Seekers Figure A3 Panel (c) presents the evidence for unemployed job seekers in GSOEP. We exploit the panel structure of the survey and plot employment rates by event time around the survey, where we note that importantly the reservation wage question underlying our wedge proxy is only asked for unemployedjob seekers.

Before the survey year, there is a clear pecking order: high-wedge workers are substantially less likely to be employed (40% five years before, less than 60% the year before) compared to low-wedge workers (more than 60% five years before, and nearly 80% in the pre-survey year). The picture is somewhat noisier less pronounced *after* the survey, although the ranking is stable. Perhaps the event that selects the GSOEP respondent into the reservation wage question – unemployment – is associated with a reshuffling of potential earnings introducing measurement error going forward.

Figure A3 Panel (e) plots the corresponding results for PASS, where we can use the stated subjective *expected* reemployment wages (again for workers sampled during unemployment episodes), and link the data with administrative employment biographies to track workers nearly over their entire life cycle. Here we focus on the binary distinction between workers declaring themselves willing to work at a lower wage and not, finding a clear consequences of this distinction before and after the unemployment spell and interview date. Our employment outcomes are of administrative quality due to our linkage with social security records for the survey respondents. We relegate the continuous version to the Appendix, noting that these results did not result in clear patterns, perhaps because of failure of the survey to elicit reservation wages from everyone rather than only for workers declaring themselves willing to work below the expected wage before (and only if yes) stating the reservation wage.

Interpretation There are three potential sources of potential discrepancies: measurement error in the original wedges, idiosyncratic shocks (limited persistence) in the wedge, or frictions that detach realized and desired employment allocations.

Assessing the role of frictions in employment allocations is beyond the scope of our paper. Instead, we close with an attempt a suggestive hint asking whether higher unemployment, the canonical symptom of rationed labor and labor market frictions, may cause, or reflect, higher allocational frictions inducing less-efficient rationing. In Figure A3 Panel (d) we revisit the German GSOEP sample, and split the survey waves in half: a high-unemployment time before 2006 (steadily around 10%), and after 2006 when unemployment sharply declined to 7% and recently even lower. The employment–wedge gradient appears somewhat flatter during high-unemployment area.

C Polynomial Approximation of Representative Household Aggregate Employment Disutility $V(E)$ to Empirical Wedge Distribution

In this section we describe how we choose the polynomial approximation of $V(E)$ from the survey data. Given a polynomial degree d, the goal is to choose the polynomial $p^*(E)$ such that

$$\begin{aligned} p^*(E) = \arg\min_{p(E)\in P_d(E)} \sum_{i=1}^{N} \omega_i \left(p(E_i) - (1-\xi_i)\right)^2 \\ \text{s.t. } p^{*\prime}(E) \geq 0 \ \ \forall E \in [0,1] \end{aligned}$$

where $P_d(E)$ is the set of polynomials of degree d and i indexes the empirical observations. We select the polynomial degree by informal visual experimentation. Weights are of the form $\omega = [\left|(1-\tau) - 1\right| + 0.01]^{-2}$, hence assigning more weight to local wedge (and hence employment) deviations e.g. relevant to business cycle fluctuations.

In lieu of the actual non-negativity constraint on the derivative of $p^*(E)$, we approximate this constraint:

$$\begin{aligned} p^*(E) = \arg\min_{p(E)\in P_d(E)} \sum_{i=1}^{N} \omega_i \left(p(E_i) - (1-\xi_i)\right)^2 \\ \text{s.t. } p^{*\prime}(E_j) \geq 0 \ \ \forall E_j \in \{E_1, E_2, \cdots, E_J\} \end{aligned}$$

where $E_1, E_2, \cdots, E_J$ are a set of J points in $[0,1]$. In other words, we check that the derivative is positive at many points in the interval. This is computationally simple to implement. For a candidate polynomial $p(E) = p_0 + p_1 E + p_2 E^2 + \cdots + p_d E^d$, the constraints can be written as:

$$\begin{aligned} p^{*\prime}(E_j) \geq 0 \ \ \forall E_j \in \{E_1, E_2, \cdots, E_J\} \\ p_1 + 2p_2 E_j + 3p_3 E_j^2 + \cdots + d p_d E_j^{d-1} \geq 0 \ \ \forall E_j \in \{E_1, E_2, \cdots, E_J\} \end{aligned}$$

$$\begin{bmatrix} 0 & 1 & 2E_1 & 3E_1^2 & \cdots & dE_1^{d-1} \\ 0 & 1 & 2E_2 & 3E_2^2 & \cdots & dE_2^{d-1} \\ \vdots & & & & & \\ 0 & 1 & 2E_J & 3E_J^2 & \cdots & dE_J^{d-1} \end{bmatrix} \begin{bmatrix} p_0 \\ p_1 \\ p_2 \\ \vdots \\ p_d \end{bmatrix} \geq \begin{bmatrix} 0 \\ 0 \\ 0 \\ \vdots \\ 0 \end{bmatrix}$$

which is a linear restriction in $[p_0, p_1, \cdots p_d]$. One can similarly write the restriction that $p^*(E) \geq 0$ as a linear restriction on the coefficients of the polynomial. This problem can then be passed to an appropriate solver, where we use the ECOS solver through Julia's Convex.jl package (Udell, Mohan, Zeng, Hong, Diamond, and Boyd, 2014). We check the constraint with $J = 100{,}000$ equally spaced points in $[0,1]$.

In this particular application, we find that the constrained polynomial fits the data almost as well as that of an unconstrained polynomial of the same degree; in fact, the derivative of the polynomial chosen without constraints (unconstrained weighted least squares) is positive over much of the domain. The weighted R^2s of the unconstrained and constrained regressions are 0.9802 and 0.9800 respectively.

D Additional Tables

Table A1: Descriptive Statistics of the Reservation Wedge Proxy from Reservation Wage Surveys of Unemployed Job Seekers: GSOEP, PASS and Pole emploi

Measure	Empirical Statistic		
	A. GSOEP	B. PASS	C. Pole Emploi
Mean	1.22	0.75	0.94
Median	0.83	0.84	0.93
25 Pctile.	0.64	0.75	0.83
75 Pctile.	1.2	≥ 1.0	1.01
Pct. < 1	61.0%	72.8%	70.5%
Pct. $= 1$	6.00%	-	-
Pct. > 1	33.0%	27.2%	29.5%
Pct. > 2	11.3%	-	0.1%
Variance	2.05	0.19	0.31
Skewness	6.43	-1.45	6.43
Kurtosis	70.83	5.55	7.44

Deviation from 1	+/-	+	-	+/-	+	-	+/-	+	-
	A. GSOEP			B. PASS			C. Pole Emploi		
0.01	6.09%	0.11%	0.07%	-	-	-	6.23%	3.03%	3.20%
0.03	6.67%	0.52%	1.09%	-	-	0.1%	16.6%	7.48%	9.27%
0.05	6.79%	1.09%	1.41%	-	-	0.5%	25.4%	10.4%	15.0%
0.10	8.50%	3.78%	5.96%	-	-	4.6%	45.6%	16.1%	29.5%

Note: The table reports summary statistics of the empirical reservation wage proxies constructed as the ratio of reservation wages to a proxy for a potential wage (e.g. the previous wage), with the construction and correspondence to the reservation wedge concept described in Appendix B.1. The "+/-" column denotes the fraction within a band around 1.00 with radius according to the row. The "+" and "-" columns denote the fraction of reservation wedges on the positive or negative side of that band, not including reservation wedges equal to 1. Associated histograms are presented in Figure A2. *Sources:* German Socio-Economic Panel (for GSOEP column); PASS-IAB linked data (for PASS columns); Le Barbanchon, Rathelot, and Roulet (2017) for the Pole Emploi columns. Some PASS entries are empty due to disclosure restriction and/or due to the censoring above 1.00 in the wedge.

Table A2: GSOEP Covariate Analysis: (Log) Reservation Wedge for German Job Seekers

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Age / 100	-4.860***	-3.980***	-5.039***	-4.731***	-5.251***	-5.133***	-4.572***
	(0.462)	(0.493)	(0.460)	(0.462)	(0.463)	(0.459)	(0.415)
$(\text{Age} / 100)^2$	4.871***	3.898***	5.038***	4.713***	5.381***	5.171***	4.567***
	(0.593)	(0.639)	(0.590)	(0.593)	(0.595)	(0.589)	(0.525)
Female	0.003	0.012	0.024	0.019	-0.004	0.012	0.033*
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
Years Edu.	-0.029***	-0.029***	-0.024***	-0.029***	-0.029***	-0.024***	-0.023***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Partnered		-0.095***					-0.074***
		(0.014)					(0.014)
Any Children		-0.031*					-0.031*
		(0.015)					(0.015)
Satis. Income Medium			-0.117***				-0.072***
			(0.014)				(0.015)
Satis. Income High			-0.213***				-0.147***
			(0.019)				(0.020)
Satis. Housework Medium				-0.093***			-0.066***
				(0.015)			(0.015)
Satis. Housework High				-0.109***			-0.047**
				(0.017)			(0.017)
Satis. Leisure Medium					-0.103***		-0.095***
					(0.018)		(0.018)
Satis. Leisure High					-0.134***		-0.108***
					(0.017)		(0.017)
Concerned Finances (somewhat)						0.079***	0.049*
						(0.022)	(0.021)
Concerned Finances (very)						0.166***	0.094***
						(0.022)	(0.022)
Constant	1.309***	1.186***	1.368***	1.348***	1.475***	1.197***	1.326***
	(0.083)	(0.086)	(0.083)	(0.083)	(0.086)	(0.086)	(0.080)
N	9817	9817	9817	9817	9817	9817	9817
R^2	0.06	0.06	0.07	0.06	0.06	0.07	0.08

Note: The table reports coefficients from a regression of individual-level empirical reservation wage proxies on survey covariates for unemployed job seekers (constructed as the ratio of reservation wages to a proxy for a potential wage (e.g. the previous wage), with the construction and correspondence to the reservation wedge concept described in Appendix B.1). $*$: $p < 0.10$, $**$: $p < 0.05$, $***$: $p < 0.01$. Robust standard errors in parentheses. Construction of reservation wedges and sample are described in main text. *Source:* German Socio-Economic Panel (GSOEP).

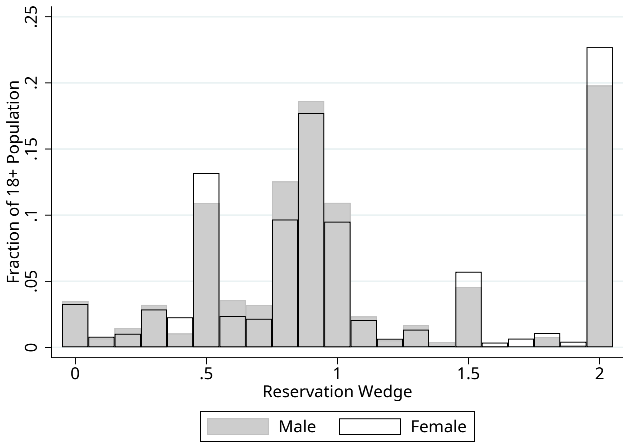
Table A3: PASS Covariate Analysis: Tobit Regression of (Log) Reservation Wedge Proxy for German Nonemployed (Right-Censored at 0 (Log(1))

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Female	-0.055***	-0.035***	-0.050***	-0.054***	-0.053***	-0.056***	-0.049***
	(0.011)	(0.004)	(0.012)	(0.011)	(0.011)	(0.011)	(0.013)
Age	0.004	0.004***	0.005*	0.005*	0.004	0.005*	0.006**
	(0.003)	(0.001)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Age^2	-0.000	-0.000*	-0.000	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Searching for Work	0.022**	0.007*	0.020*	0.022**	0.019*	0.022**	0.019*
	(0.011)	(0.004)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
Partnered		-0.011	-0.017				-0.015
		(0.014)	(0.018)				(0.018)
Kids		-0.003	-0.014				-0.016
		(0.018)	(0.022)				(0.022)
Partnered × Kids			0.016				0.018
			(0.025)				(0.026)
Log Years Education				-0.013			-0.006
				(0.038)			(0.029)
Life Satisfaction (Medium)					-0.011		-0.051
					(0.011)		(0.057)
Life Satisfaction (High)					-0.016		0.057
					(0.016)		(0.063)
Home Satisfaction (Medium)						-0.007	-0.081
						(0.013)	(0.055)
Home Satisfaction (High)						0.006	-0.016*
						(0.015)	(0.082)
Health Issues						0.006	0.034
						(0.015)	(0.123)
Constant	-0.269***	-0.271***	-0.278***	-0.018***	-0.258***	-0.271***	-0.288***
	0.055	0.022	0.056	0.088	0.056	0.058	0.091
N	25,964	25,964	25,964	25,915	25,955	25,964	25,899

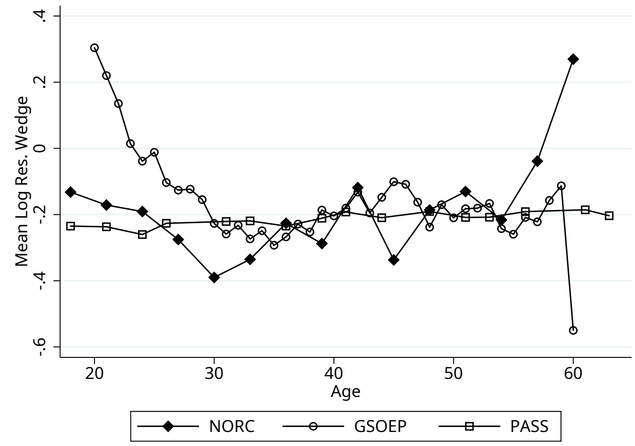
Note: The table reports coefficients from a regression of individual-level empirical reservation wage proxies on survey covariates for unemployed job seekers (constructed as the ratio of reservation wages to a proxy for a potential wage (e.g. the previous wage), with the construction and correspondence to the reservation wedge concept described in Appendix B.1). *: $p < 0.10$, **: $p < 0.05$, ***: $p < 0.01$. Robust standard errors in parentheses. For lack of a goodness-of-fit measure for a Tobit regression using survey data, we do not report any R^2-like statistics. *Source:* Panel Study Labour Market and Social Security (PASS) survey from the Institute for Employment Research (IAB), Germany.

E Additional Figures

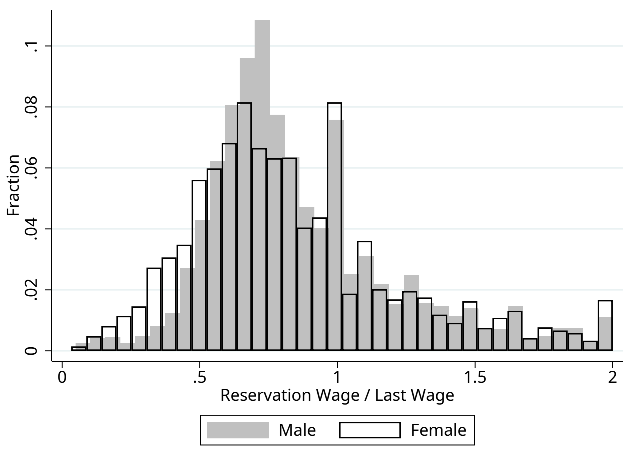
Figure A1: Distribution of Reservation Wedges



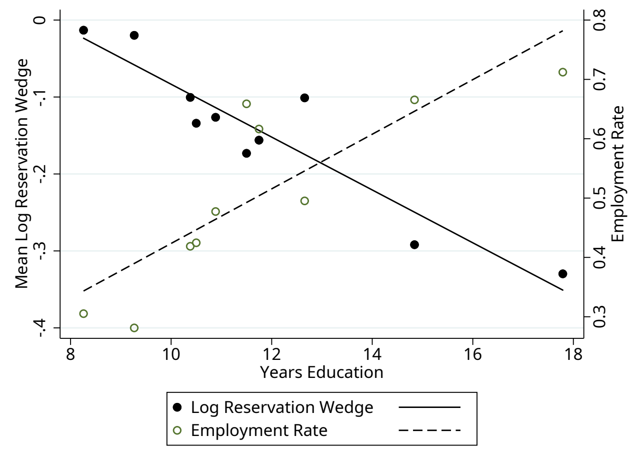
(a) U.S. Population (NORC): Distribution by Gender



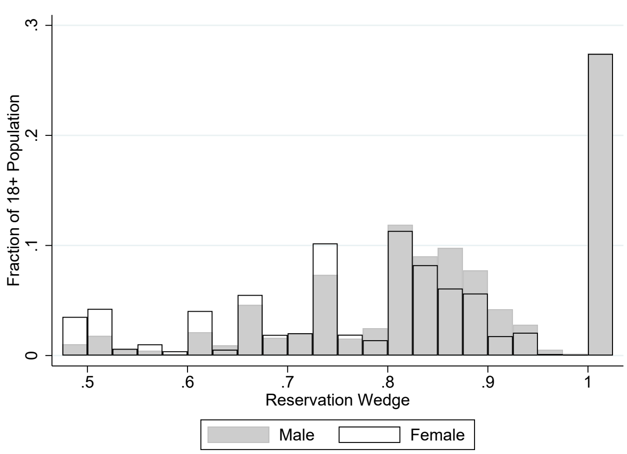
(d) Reservation Wedges by Age



(b) GSOEP: Distribution by Gender



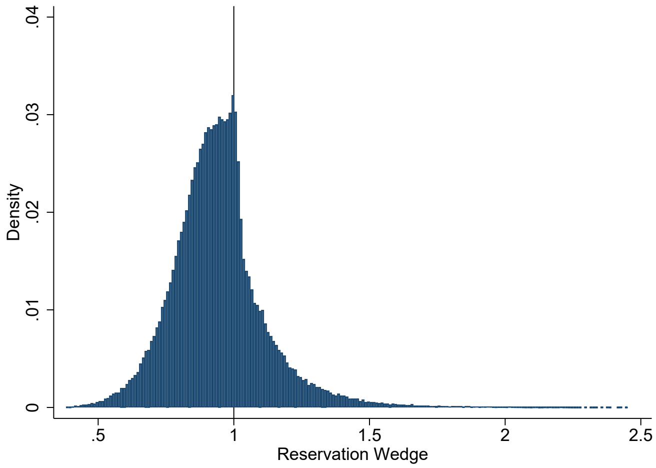
(e) GSOEP: Wedges by Years of Education



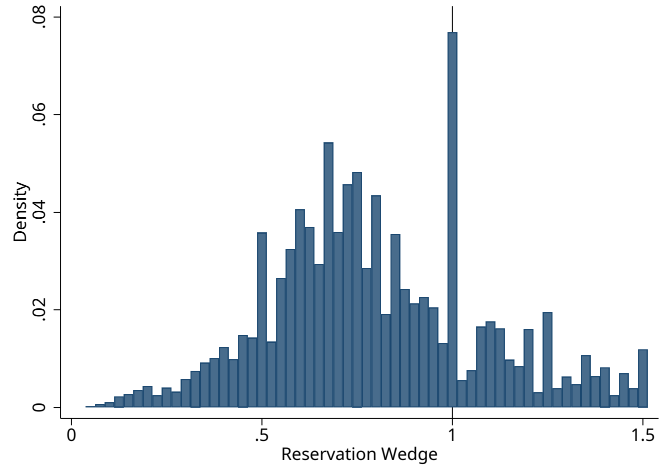
(c) PASS: Distribution by Gender

Note: The figure plots additional properties of the empirical reservation wedge distributions discussed in Section 3. Panels (a)-(c) plot histograms of reservation wedges by gender for three surveys: U.S. population (NORC, authors' survey), GSOEP and PASS. Panel (d) plots a binned scatter plot of the log reservation wedge against age bins (three-year averages for NORC; one-year for GSOEP; and unweighted three-year averages for PASS). Data for ages 66 in NORC are binned together as one. PASS wedges are coefficients from a Tobit regression of the log reservation wedge on a saturated set of age dummies (age 18 omitted). Panel (e) plots, in the GSOEP, the gradients of employment rates and the mean wedge against years of education. the The construction of the wedge proxies are detailed in the main text for NORC, and in Appendix B.1 for GSOEP and PASS. Wedges and wedge proxies for the NORC and GSOEP data are truncated at 2.0. Wedges for the PASS data are by construction truncated at 1.0 due to the survey question.

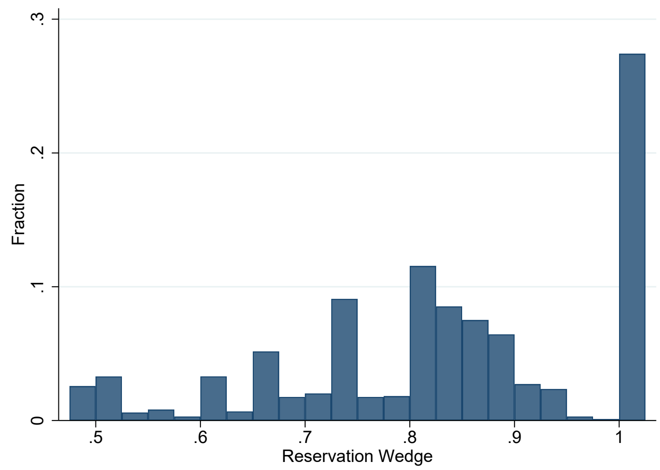
Figure A2: Distribution of Reservation Wedges from Three Reservation Wage Surveys of Unemployed Job Seekers: Pôle Emploi Administrative Survey, GSOEP Household Survey, PASS-IAB Admin-Linked Household Survey



(a) Pôle Emploi



(b) GSOEP

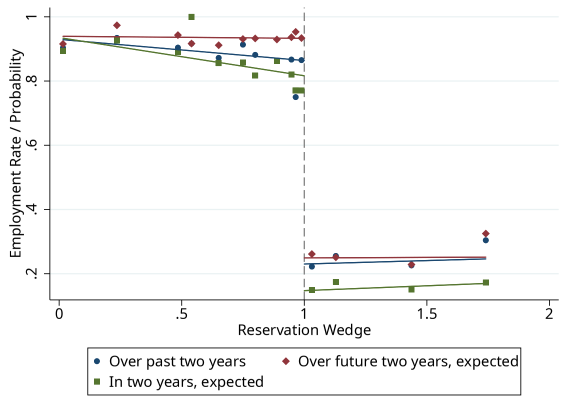


(c) PASS

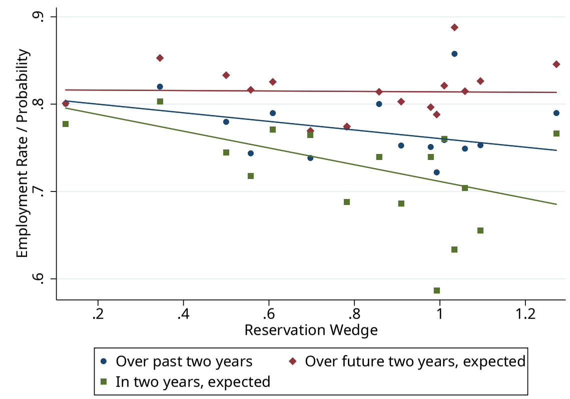
Note: The figure plots histograms of reservation proxies from sureys of (unemployed) job seekers (constructed as the ratio of reservation wages to a proxy for a potential wage (e.g. the previous wage), with the construction and correspondence to the reservation wedge concept described in Appendix B.1). Associated summary statistics are reported in Table A1. PASS wedges less than 0.5 and greater than 1 are grouped in the left-most and right-most bars, due to data disclosure requirements. PASS includes unemployed and out of the labor force individuals reported to have ever searched (rather than current searchers only). *Sources:* German Socio-Economic Panel (GOSEP); PASS-IAB linked data; Pole Emploi French UI Agency data (provided by Le Barbanchon, Rathelot, and Roulet, 2017).

Figure A3: Employment Dynamics, by Reservation Wedges

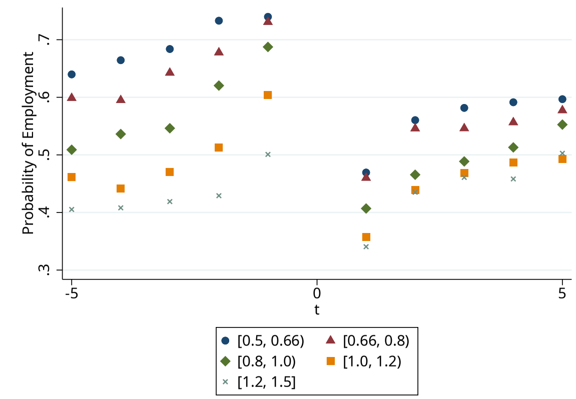
(a) US Survey: Pooling All Labor Force Statuses



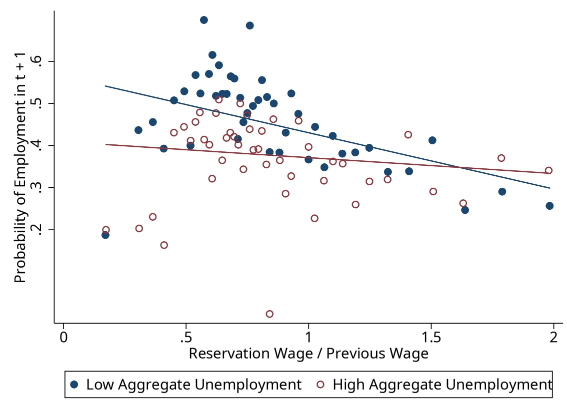
(b) US Survey: Controlling for Labor Force Status



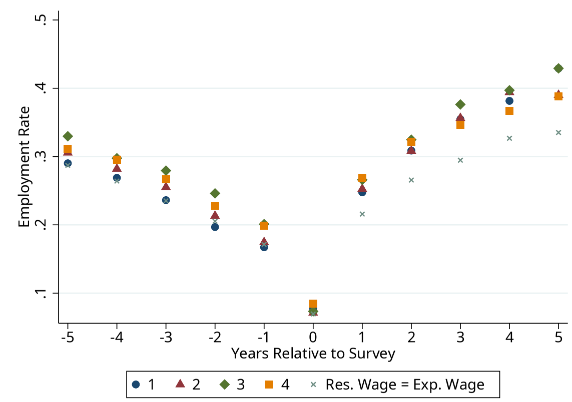
(c) GSOEP: Employment Dynamics by Reservation Wedges



(d) GSOEP: Employment Dynamics by Reservation Wedge, by Aggregate Labor Market State

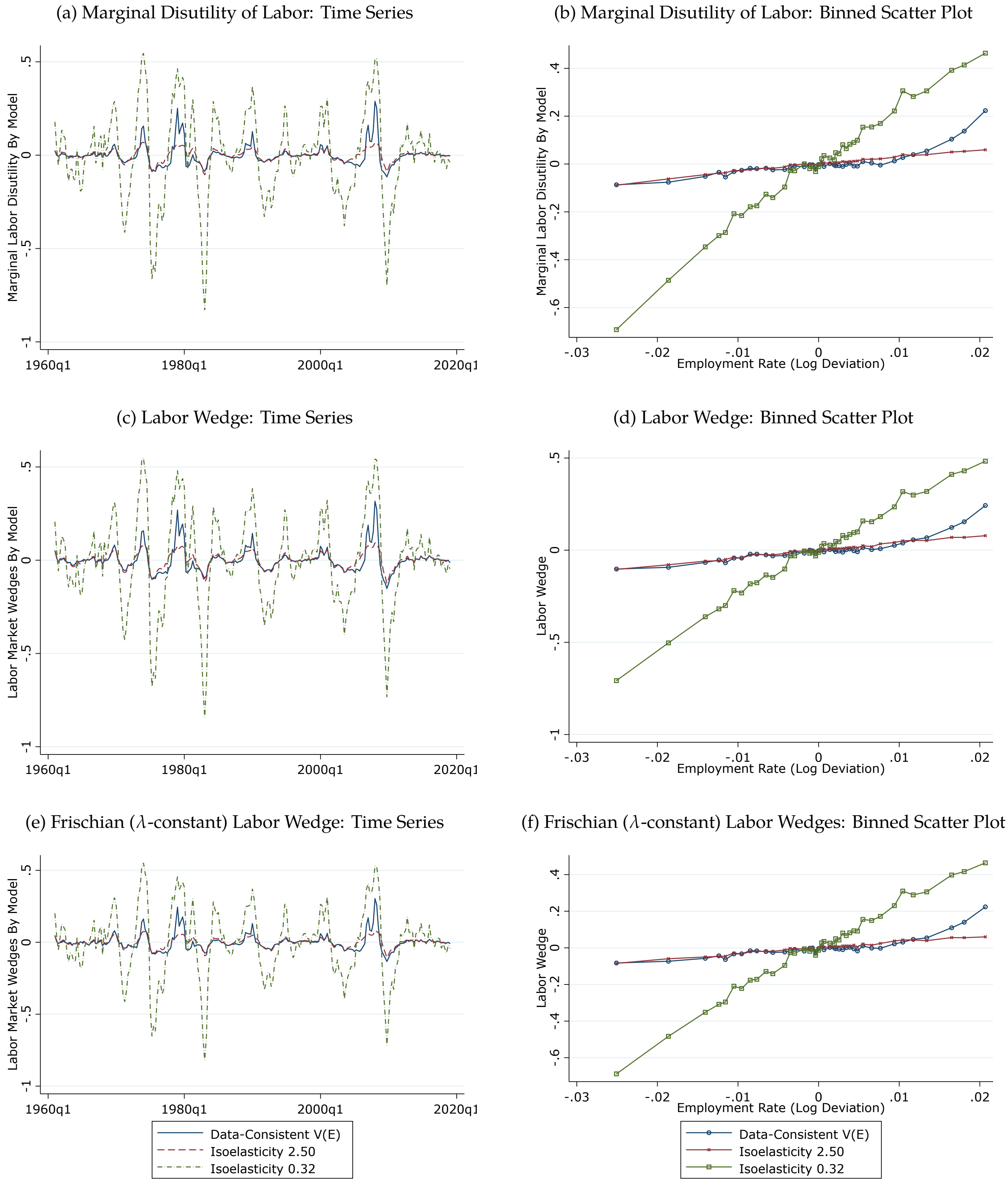


(e) Administrative Data & PASS Merge: Future and Past Employment Rates by Reservation Wedge Proxy



Notes: The figure shows individual-level realized or expected employment rates for individuals grouped by their reservation wedge proxy elicited at a given survey date. The construction of the proxies for PASS and GSOEP are in Appendix B, along with interpretation of all panels. Panels (a) and (b) are binned scatter plots of the U.S. survey, plotting on the y-axis three outcomes (questions pasted in Section B.2) denoting (i) the share of months worked over the past 24 months, (ii) over the next 24 months, and (iii) the probability assessment of employment two years post-survey. On the x-axis, the graph sorts workers into quantiles (bins) by their reservation wedge. Panel (c) plots the raw relationship;, the drop arises from employed and unemployed workers having wedges below one and are likely to work or have worked; wedges above one are out of the labor force. Panel (d) moreover residualizes both axes by a fixed effect for labor force status. Panel (c) plots the probability (share) of employment pre and post survey date (years on the x-axis) using the panel structure of the survey. Since in GSOEP, reservation wages are only elicited for unemployed job seekers, this outcome is by construction zero (and hence omitted) at the zero time period. Panel (d) takes the GSOEP panel and plots the one-year-ahead outcome but splits up the sample by the unemployment rate, showing that the slope between employment and wedges is steeper in tight labor markets, perhaps reflecting more efficient rationing. (Specifically, we split the survey waves in half: a high-unemployment time before 2006 (steadily around 10%), and after 2006 when unemployment sharply declined to 7% and recently even lower.) Panel (e) uses a merged version of the PASS survey and the IAB German social security administrative data to plot employment rates (an admin. snapshot at the survey date and the same dates in the other years) and the wedge proxy. Due to disclosure requirements and sample sizes, PASS respondents are split by quartiles of the reservation wedge proxy, with a separate group for those whose wage is not lower than their expected wage (only then is the reservation wage elicited). The PASS sample includes the unemployed and out of the labor force reported to have ever searched (rather than current searchers only), explaining why pre and post employment is below GSOEP; positive employment at point of survey reflects admin.-data-based employment. Sources: GSOEP; PASS-IAB matched data set; GSOEP; authors' U.S. custom (NORC) survey.

Figure A4: Cyclical Implications: Marginal Labor Supply Disutilty and Labor Market Wedges **Implied By 10-Fold Increases in E_t Deviations from Trend in E Entering** $V'(E)$ (Log Deviations From Trend, Quarterly Data)



Note: The figure extends the labor wedge analysis described in Section 5.2. It replicates Figure 8 but ad-hoc amplifies the employment fluctuations entering the marginal disutility of labor $V'(E)$ 10-fold (while feeding the baseline E_t into the other elements). It thereby highlights that locally, the curve acts as a high-elasticity ones and at the aggregate business cycle level, unrealistically large employment fluctuations are needed for the curve to reach the lower-elasticity region. As in baseline Figure 8, Panels (a) (time series) and (b) (binned scatter plot of MRS against the employment rate) plot the model-implied marginal disutilities of labor and implied labor market wedges for U.S. business cycles. Panels (c) and (d) plot the aggregate labor wedges, the gap between the MPL and the MRS. Panels (e) and (f) plot the labor wedges that hold λ (consumption) constant, i.e. only reflect shifts in the marginal disutility of labor $V'(E)$ against the MPL. The plots reflect three models of a representative household that only differ only in aggregate disutility of employment $V(E)$: Frisch (MaCurdy (1981)) isoelasticities of 0.32 and 2.50, and the data-consistent disutility curve $V(E)$, as described in Section 5.1. All time series are HP-filtered log quarterly time series with smoothing parameter of 1,600.