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

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March, 2019

Preliminary. Please Do Not Circulate.

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 household-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 encoding and collapsing rich multi-dimensional heterogeneity in, e.g., tastes for leisure, marginal utilities of consumption, hours constraints, and worker-specific wages. The CDF of the reservation wedges *is* the aggregate labor supply curve. In a meta study, we demonstrate how the reservation wedge serves as a bridge between diverse models where the aggregate labor supply curve is otherwise difficult to characterize and interrelate. The wedges are also empirically tractable: we measure them in a customized household survey for a representative sample of the U.S. population – and thereby map out the complete empirical aggregate labor supply curve at the extensive margin for the U.S. – a potential calibration target for labor supply blocks of macro models. The empirical curve implies large heterogeneity, yet locally implies a Frisch elasticity of around 3. Finally, we study micro covariates of the wedges vis-à-vis theoretical drivers.

*We thank Chaoran Yu for excellent research assistance. For comments we thank Mark Bils, Luigi Pistaferri and (for previous working paper "The Labor Supply Curve with Long-Term Jobs", on which this paper builds), David Card, Michael Elsby and David Romer, and seminar audiences at Columbia University, the Federal Reserve Bank of Minneapolis, the Federal Reserve Bank of New York, Stanford University/SIEPR, University of California, Berkeley and Davis, and University of Texas, Austin. For financial support of the custom survey, we thank Stanford's SIEPR, the Clausen Center and the Institute for Research on Labor and Employment at UC Berkeley, and NORC at U Chicago. We thank Thomas Le Barbanchon, Thomas, Roland Rathelot, and Alexandra Roulet for sharing the aggregated data on administrative reservation wage distributions of French UI recipients.

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1 Introduction

The aggregate labor supply curve – the sum of households' desired labor supply as a function of homogeneous shifts in the wage – is a core feature of macroeconomic models. In market-clearing equilibrium models, in which households are always on their labor supply curve, 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 curve also enters welfare costs of any potentially inefficient employment adjustment, and scales the amplitude of cyclical labor wedges.

Despite its theoretical centrality, labor supply blocks in macroeconomic models commonly rely on ad-hoc abstractions, for instance conventional intensive-margin hours choices (hours worked conditional on working), made by a fictional utilitarian head of a large representative household with a pooled budget constraint. This simplification stands in tension with empirical adjustment of labor aggregates primarily along the extensive, employment margin. By contrast, richer household blocks with atomistic labor supply often lack an extensive margin, or feature an overwhelming degree of interrelated heterogeneity, hence precluding the simple-to-parameterize aggregate labor supply curve convenient for calibration and quantitative analysis in macroeconomic models.

We present a theoretically robust yet tractable framework to conceptualize and quantitatively analyze aggregate labor supply curve at the extensive margin. Individuals make discrete choices over employment, which we summarize in form of a micro *reservation (labor) wedge*: a tax-like gap $1 - \tau^*_{it}$ between the individual's idiosyncratic potential earnings and her idiosyncratic marginal rate of substitution. Intuitively, the wedge corresponds to the net-of-income-tax rate, or wage mark-up or mark-down, that would render individual i indifferent between employment and nonemployment. Hence the wedge, capturing worker surplus from employment, is a sufficient statistic for each worker's extensive-margin labor supply behavior, summarizing rich heterogeneity in, e.g., tastes for leisure or disutility from working, marginal utilities of consumption, hours constraints, and potential wages. It also accommodates intensive margin choices, long-run (rather than Frischian) horizons, and a variety of frictions and extensions.

The cumulative distribution function of the micro wedges fully characterizes – *is* – the aggregate labor supply curve: structurally different models will exhibit the same labor supply behavior if and only if they are isomorphic in their reservation wedge distribution. As its argument, the curve takes a generalized aggregate wage concept: the *prevailing* aggregate wedge $1 - \mathcal{T}_t$. Shifts in this prevailing wedge, due to aggregate wage growth, linear taxes, labor demand shocks or labor market frictions, sweep up *marginal workers* – whose reservation wedges are around the prevailing aggregate wedge and who hence drive extensive-margin adjustment.

In a meta study, we show how the reservation wedge distribution serves as a unifying bridge between structurally widely different labor supply blocks, unveiling and visualizing the full aggregate labor supply curves otherwise difficult to characterize and interrelate. We first analyze models of representative, full-insurance households with ad-hoc MaCurdy labor supply (Gali, 2015) and fully indivisible labor (Hansen, 1985; Rogerson, 1988). We also integrate an *intensive* margin choice, and apply this insight to the Rogerson and Wallenius (2008) model of lifecycle choices at both margins. We then introduce an extensive-margin choice into atomostic heterogeneous agent models with borrowing constraints (Achdou, Han, Lasry, Lions, and Moll, 2017; Debortoli and Galí, 2017; Kaplan, Moll, and Violante, 2018), with heterogeneity in wages as well as the shadow value of income.

The framework provides a consistent definition as well as direct characterization of this aggregate extensive-margin elasticity: the reverse hazard rate at $(1-\mathcal{T}_t)$, $\frac{(1-\mathcal{T}_t)f_t(1-\mathcal{T}_t)}{F_t(1-\mathcal{T}_t)}$, the density of marginal over total employment. It can be read off the reservation wedge distribution as well as be defined for non-infinitesimal variations. Our framework also clarifies that this elasticity is constant if the reservation wedges are power-distributed – which occurs if *any* one wedge-relevant component is power-distributed, hence permitting various potential origins of this property. For example, the popular ad-hoc specification of representative households exhibiting intensive-margin-like MaCurdy preferences $(u(c) - L^{1+1/\varepsilon})$ emerges is the disutility of participation is power-distributed, with homogeneous wages (by assumption) and shadow values of income (due to a pooled budget constraint).

To assess the empirical analogue of the curve, we implement a custom survey eliciting reservation wedges in form of the tax/subsidy rendering a given individual indifferent between nonemployment and employment. Our representative survey covers the U.S. and all labor force groups. The CDF of the wedges nonparametrically traces out the full *empirical* aggregate labor supply curve at the extensive margin. The reservation wedge distribution therefore also serves as a bridge between the empirical as well as the model-implied labor supply curves. This comparison provides a goodness-of-fit test of a given model-distribution and the empirical target (e.g., using a Kolmogorov-Smirnov test). The empirical curve can therefore serve as a calibration target for labor supply blocks, for which the reservation wedge distribution serves as the *sufficient statistic*, capturing detailed model-specific features including distributional assumptions, a variety of parameterizations and equilibrium outcomes.

The empirical histograms of the wedge distribution exhibit a spike around one – where the reservation wage is close to the individual's actual wage and where marginal workers are located in the wedge distribution. Still, the distribution is widely dispersed, implying that the typical worker is inframarginal in that she derives considerable worker surplus from employment, consistent with models of heterogeneity in job quality (Mortensen and Pissarides, 1994; 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) and, e.g., textbook DMP models without heterogeneity.

Inspecting the empirical CDF, we find a local Frisch elasticity of desired extensive-margin labor supply of around 3. Interestingly, this value is close to calibrations of macroeconomic models, yet an order of magnitude than larger than quasi-experimental estimates of realized employment adjustment to short-run net-wage changes,Chetty et al. (2012). However, the empirical arc elasticity is far from constant for non-infinitesimal intervals, as the empirical curve is distributed in a way not easily described by a parametric distribution.

To understand this potential discrepancy, we reiterate that our framework and empirical implementation trace out *desired* spot-market labor supply, i.e. underlying preferences. Our framework is therefore decidedly agnostic and prior to potential real-world frictions such as search or wage rigidities, which may detach desired from actual employment allocations. Hence, our focus on (stated) preferences contrasts with, e.g., an empirical investigation of the *realized* employment effects of tax changes (e.g. Chetty, Guren, Manoli, and Weber, 2012; Martinez, Saez, and Siegenthaler, 2018; Sigurdsson, 2018), which in the presence of frictions need neither perfectly reveal preferences nor solely reflect micro choices. These estimates are therefore appropriate to calibrate the entire labor market structure of a given model, whereas our contribution helps guide the deeper structural parameters guiding labor supply preferences, a necessary model ingredient to generate behavioral responses that is perhaps prior to market structure.[1]

To assess the *degree and incidence* of such rationed labor supply, we close with an empirical exercise comparing an individual's reservation wedge with her realized employment outcomes. We use a panel dimension of our custom survey, and supplement our analysis for existing panel surveys of unemployed job seekers in Germany, France, and the United States, for whom we show we can generate wedge proxy in form of the ratio of an individual's reservation wage to the actual/potential wage. We also link one survey to (German) administrative social security covers covering their pre- and post-interview labor market biographies. Here we find considerable evidence that realized employment fluctuations are far from closely aligned with Frischian labor supply preferences, either suggesting measurement error in the wedges or limited room for short-run labor adjustment as would arise from a variety of labor market frictions and features missed in the spot market benchmark.

Outline In Section 2, we provide the general labor supply framework, define the individual-level reservation wedge, and derive the aggregate labor supply curve. Our meta study in Section 3 applies this framework to existing supply blocks. In Section 4 we construct the empirical counterparts of the wedges, and assess their covariates and the relationship between the wedge-implied desired labor supply and realized employment allocations. We construct the empirical wedge distribution. In Section 5 we compare the model-implied distributions against this empirical benchmark and discuss potential implications for calibration targets of labor supply blocks of macroeconomic models. We also review additional related literature below.

Additional Related Literature There is a considerable existing literature on the aggregate labor supply curve as well as extensive-margin choices. Our contribution is distinct from and fills a gap left between this important set of papers presenting and estimating distinct parametric models, by contributing a general unifying framework that is nonparametric and delivers an empirically

[1] 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).

tractable as well as model-independent *sufficient-statistics*, capable of interrelating various models as well as data.

First, on the macroeconomic side, our paper shares one intermediate step, namely to explicitly think of aggregate extensive-margin employment adjustment to be driven by marginal workers in a distribution of reservation *wages* (Chang and Kim, 2006, 2007; Gourio and Noual, 2009; Park, 2017). Unlike our paper, these papers each present one specific model of aggregate labor supply with heterogeneity, and provide parametric estimations of the calibrated model relying on model-specific as well as distributional assumptions.[2] Our paper differs from these more specific treatments in our goal to provide a nonparametric and hence generalized reservation wedge distribution, which we show is more model-independent and moreover can be directly measured in survey as a single response. Moreover, directly tracing out desired labor supply, our empirical implementation does not require assumptions about Walrasian labor market clearing. [3] As one additional result, the framework then also permits us to the empirical curve back to any given model's analogue.

The second literature to which our paper connects is the structural estimation of rich micro labor supply models. Attanasio, Levell, Low, and Sánchez-Marcos (2018) and Beffy, Blundell, Bozio, Laroque, and To (2018) estimate a structural model for female labor supply behavior at the micro level including an extensive margin; the former authors then also include a simulation-based computation of extensive-margin Frisch elasiticites for women.[4] Our paper instead provides a sufficient-statistics approach to labor supply preferences for the Frischian extensive margin that can be elicited in a household survey about employment preferences.

2 Framework: Micro Reservation Wedges and Aggregate Labor Supply

We micro-found the extensive-margin aggregate labor supply curve from discrete choices between employment and nonemployment by individual households. We summarize these micro employment choices in the form of an allocative sufficient statistic: the individual reservation (labor) wedge, which is the labor tax that would render an individual indifferent between employment and nonemployment. This statistic encodes a variety of sources of heterogeneity and is theoretically robust across model classes. The aggregate labor supply curve *is* the CDF of the reservation wedge distribution. It traces out the fraction of households desiring to work as a function of the prevailing aggregate wedge – a generalized notion of an aggregate wage.

[2] For example, Park (2017) assumes homogeneous labor supply disutility and uses measured consumption with imputed wages and distributional assumptions to back out empirical reservation wage levels. 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.

[3] Erosa, Fuster, and Kambourov (2016), who do not derive reservation wages, permit worker flows and exogenous separation shocks.

[4] Compositional differences between group-specific Frisch elasticities are highlighted and estimated in reduced form in Fiorito and Zanella (2012) and Peterman (2016). Keane and Rogerson (2012) and Keane and Rogerson (2015) review mechanisms by which aggregate extensive-margin Frisch elasticities may be larger than implied micro Frisch elasticities.

2.1 Micro Labor Supply

Household's Problem Consider an individual i with utility $u_i(c_i, h_i)$ from consumption c_i and hours worked h_i, with budget Lagrange multiplier λ_i:

$$\max_{a_{it},h_{it},c_{it}} \mathbb{E}_t \sum_t u(h_{it}, c_{it}) \tag{1}$$

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

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 $v_{it} = u(c^e_{it}, \widetilde{h}) - u(c^n_{it}, 0)$. Besides standard hours disutility, v_{it} may also include fixed partipication costs (Cogan, 1981; Attanasio, Levell, Low, and Sánchez-Marcos, 2018; Beffy, Blundell, Bozio, Laroque, and To, 2018). We will put concrete structures on these terms below and by reviewing particular models in Section 3. $T_{it}(.)$ denotes non-labor taxes and transfers.

We also include an prevailing aggregate wage labor wedge $1 - \mathcal{T}_t$, capturing, e.g., changes in labor taxes, or some homogeneous wage growth shifter to which micro wages w_{it} are proportionate, or any factor affecting the return to working. $1-\mathcal{T}_t$ generalizes the standard homogeneous aggregate wage to our setting with potential heterogeneity in idiosyncratic wages.

Optimal labor supply assigns each i her hours $h_{it} \in \{\widetilde{h}_{it}, 0\}$ following a cutoff rule:

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

That is, her discrete choice selects employment if the benefits, $(1 - \mathcal{T}_t) y_{it}\lambda_{it}$, outweigh the cost, v_{it}; for marginal workers, who are indifferent between working and not, the condition holds with equality. Equivalently, due to indivisible labor, the discrete choice determines her employment status $e_{it} \in \{0, 1\}$:

$$\Rightarrow e^*_{it} = \begin{cases} 0 & \text{if} \quad (1 - \mathcal{T}_t) y_{it}\lambda_{it} < v_{it} \\ 1 & \text{if} \quad (1 - \mathcal{T}_t) y_{it}\lambda_{it} \geq v_{it} \end{cases} \tag{4}$$

Micro Reservation (Labor) Wedges We summarize the individual's extensive-margin labor supply behavior by defining her idiosyncratic *reservation wedge* $1 - \tau^*_{it}$: the aggregate wedge $1 - \mathcal{T}_t$ that renders her *marginal* – i.e. indifferent between working and not working:

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

2.2 Aggregation

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

$$E_t(1-\mathcal{T}_t) = \int_{-\infty}^{\infty} \mathbb{1}\left(1-\tau^* \leq 1-\mathcal{T}_t\right) dF_t(1-\tau^*) \tag{6}$$

$$= F_t\left(1-\mathcal{T}_t\right) \tag{7}$$

Different microfoundations that generate the same reservation wedge distribution F also generate the same labor supply curve. The reservation wedge subsumes arbitrarily rich heterogeneity in potential wages, budget multipliers, and the labor disutility of workers. These three components in turn capture rich model-specific sources of heterogeneity, such as lifetime wealth, borrowing constraints, worker-specific skills, hours on the job, job amenities, time endowments, or tastes for leisure.

The Extensive-Margin Elasticity Consider an increase in aggregate wedge from $(1-\mathcal{T}_t)$ to $(1-\mathcal{T}_t')$. The employment response is driven by the mass of nearly-marginal workers, $F_t(1-\mathcal{T}_t')-F_t(1-\mathcal{T}_t)$: those workers nonemployed in regime $1-\mathcal{T}_t$ but employed under $1-\mathcal{T}_t' > 1-\mathcal{T}_t$, i.e. those marginal workers with reservation wedges $1-\mathcal{T}_t' < 1-\tau^*_{it} \leq 1-\mathcal{T}_t$.

The labor supply *elasticity* for discrete wedge changes is:

$$\epsilon_{E_t,(1-\mathcal{T}_t)\rightarrow(1-\mathcal{T}_t')} = \frac{F\left(1-\mathcal{T}_t'\right)-F\left(1-\mathcal{T}_t\right)}{F\left(1-\mathcal{T}_t\right)} \bigg/ \frac{(1-\mathcal{T}_t')-(1-\mathcal{T}_t)}{1-\mathcal{T}_t} \tag{8}$$

For infinitesimal changes in $(1-\mathcal{T}_t)$, the extensive margin elasticity is:

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

For a preexisting wedge equal to $1-\mathcal{T}_t=1$, the elasticity is $f_t(1)/F_t(1)$, the reverse hazard rate of the reservation wedge at threshold 1. This starting point is useful because any tax system can be subsumed in redefining initial wages w_{it} as net wages without loss of generality.

Conditions for a Constant Extensive Margin Frisch Elasticity Next we clarify the general distributional conditions for a constant extensive-margin Frisch elasticity, a convenient property for calibration often assumed in ad-hoc specifications, two of which we include in our meta study in Section 3. A power-law-like distributed wedge exhibits this property. Suppose $1-\tau^*$ follows a distribution

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

with shape parameter $\alpha_{1-\tau^*}$ with maximum $(1-\tau^*)_{\max}$ delivers an elasticity equal to $\alpha_{1-\tau^*}$:

$$\epsilon_{E_t,1-\mathcal{T}_t} = \frac{(1-\mathcal{T}_t)\frac{\alpha(1-\mathcal{T}_t)^{\alpha_{1-\tau^*}-1}}{(1-\tau^*)_{\max}^{\alpha_{1-\tau^*}}}}{\frac{(1-\mathcal{T}_t)^{\alpha_{1-\tau^*}}}{(1-\tau^*)_{\max}^{\alpha_{1-\tau^*}}}} = \alpha_{1-\tau^*} \tag{11}$$

Specifically, the distributional assumptions for the property in power-law terms 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) and a rearrangement clarify that we require the *inverse* of our wedge to follow a power distribution:

$$G_{1-\tau^*}(1-\tau^*) = P(X < 1-\tau^*) = \left(\frac{1-\tau^*}{(1-\tau^*)_{\max}}\right)^{\alpha_{1-\tau^*}} \tag{12}$$

$$\Leftrightarrow P\left(\frac{1}{1-\tau^*} < \frac{1}{X}\right) = \left(\frac{\frac{1}{1-\tau^*}}{\frac{1}{(1-\tau^*)_{\max}}}\right)^{-\alpha_{1-\tau^*}} \tag{13}$$

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

Another useful property is that such a power-like wedge distribution can emerge as long as *any one* of wedge components $(v_{it}, 1/\lambda_{it}, 1/w_{it})$ is power-distributed conditional on the other two. For example, let v_{it} follow a power distribution with maximum $v_{\max}$ and shape parameter α_v, independent from distribution of w_{it} and λ_{it} $g(w,\lambda)$. The distribution of $1-\tau^*_{it}$ is:

$$F_t(1-\mathcal{T}_t) = P\left(1-\tau^*_{it} \leq 1-\mathcal{T}_t\right) = P\left(\frac{v_{it}}{w_{it}\lambda_{it}} \leq 1-\mathcal{T}_t\right) = P\left(v_{it} < (1-\mathcal{T}_t)w_{it}\lambda_{it}\right) \tag{14}$$

$$= \int_{-\infty}^{\infty}\int_{-\infty}^{\infty} \min\left\{\left(\frac{(1-\mathcal{T}_t)w\lambda}{v_{\max}}\right)^{\alpha_v}, 1\right\} g_t(w,\lambda)dwd\lambda \tag{15}$$

An powerful case is $\left(\frac{(1-\mathcal{T}_t)w_{it}\lambda_{it}}{v_{\max}}\right)^{\alpha} < 1$ for each (w,λ)-"type". Economically, this distributional assumption implies positive nonemployment in each (w,λ)-type at $1-\mathcal{T}_t$, hence:

$$\Rightarrow F_t(1-\mathcal{T}_t) = \int_{-\infty}^{\infty}\int_{-\infty}^{\infty} \left(\frac{(1-\mathcal{T}_t)w\lambda}{v_{\max}}\right)^{\alpha_v} g_t(w,\lambda)dwd\lambda \tag{16}$$

$$= \left(\frac{1-\mathcal{T}_t}{v_{\max}}\right)^{\alpha} \int_{-\infty}^{\infty}\int_{-\infty}^{\infty} (w\lambda)^{\alpha_v} g_t(w,\lambda)dwd\lambda \tag{17}$$

which itself is a power distribution with shape parameter α_v and maximum

$1 - \tau^v_{\min} = \frac{v_{\max}}{\left[\int_{-\infty}^{\infty}\int_{-\infty}^{\infty}(w\lambda)^{\alpha} g_t(w,\lambda) dw d\lambda\right]^{1/\alpha_v}}$. That is, we have indexed the population by (w, λ). *Within* each (w, λ)-type, the reservation wedge is power-distributed since v_{it} is. So each (w, λ)-type exhibits a constant elasticity α_v. The aggregate elasticity – the weighted average of (w, λ)-types' elasticities α_v – is hence also α_v. By contrast, if $\mathcal{T}_t$ or $\tau^v_{\min}$ 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 $\alpha_v \cdot P((1-\mathcal{T}_t)w\lambda < v_{\max})$.

2.3 Extensions and Frictions

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 job choice choice j from a menu of jobs $J_{it} = \{(y_{it,j}, v_{it,j})\}_j$, each with different earnings and disutility or amenities $(y_{it,j}, v_{it,j})$. This general setting nests heterogeneity in hours $\widetilde{h}^j_{it}$, for example, i.e. the standard intensive margin, e.g. a sparse set of discrete hours options (e.g. 0, 20, or 40), or nearly continuous hours choices. But the setting is more general in that permits the worker to choose along general job attributes, nonparametrically nesting nonconvexities in payoff y or costs v.

For any given wedge $1 - \mathcal{T}_t$, we can define the household's intensive-margin job (e.g., hours) choice – where we explicitly for now ignore the participation constraint i.e. the extensive-margin choice:

$$\max_{a_{it}, j_{it} \in J_{it}, c_{it}} \mathbb{E}_t \sum_t u(j, c_{it}) \tag{18}$$

$$\text{s.t. } a_{it} + c_{it} \leq a_{i,t-1}(1 + r_{t-1}) + (1 - \mathcal{T}_t) y_{it,j} + T_{it}(.) \tag{19}$$

where optimal job choice is defined by:

$$j^*(1 - \mathcal{T}_t) = \underset{j \in J_{it}}{\operatorname{argmax}} \{(18) \text{ s.t. } (19) | 1 - \mathcal{T}_t\} \tag{20}$$

such that optimal labor supply determines an augmented cutoff rule conditioning on the job choice respectively optimal at the given prevailing wedge $1 - \mathcal{T}_t$:

$$\Rightarrow e^*_{it} = \begin{cases} 0 & \text{if} \quad (1 - \mathcal{T}_t) y_{it}^{j^*(1-\mathcal{T}_t)} \lambda_{it} < v_{it}^{j^*(1-\mathcal{T}_t)} \\ 1 & \text{if} \quad (1 - \mathcal{T}_t) y_{it}^{j^*(1-\mathcal{T}_t)} \lambda_{it} \geq v_{it}^{j^*(1-\mathcal{T}_t)} \end{cases} \tag{21}$$

Here, the extensive-margin reservation wedge is an implicitly defined fixed point, rendering the individual indifferent between working and not working, *conditional on having (re-)optimized job* *choice with respect to this to-be-determined reservation wedge*:

$$1-\tau^*_{it} = \frac{v_{it}^{j^*(1-\tau^*_{it})}}{y_{it}^{j^*(1-\tau^*_{it})}\lambda_{it}} \tag{22}$$

The job/hours choice under a prevailing wedge $1-\mathcal{T}_t$ hence need not be the relevant hours choice to pin down the reservation tax for employment, if job switching and hours reoptimization may occur.

For instance, consider the specific case in which jobs differ by hours only. With perfectly unrestricted hours choice and no nonconvexities, such as with standard MaCurdy (1981) utility specifications, we have $h^{*1/\eta} = (1-\mathcal{T})\lambda w$. Hence, the reservation wedge is trivial at $1-\tau^*_{it} = 0$, so thate $h_{it}^{j^*(1-\tau^*_{it})} = 0$, i.e. if $1-\mathcal{T} = 0$, since 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 we include in our meta study in Section 3.

Non-Frischian Variation: Long-Run Changes or Hand-to-Mouth Consumers The framework can also be generalized to study extensive-margin labor supply in response to non-Frischian shifts in taxes or wages, in response to which λ need not remain constant. Let $1-\mathcal{T}_{t,t+\Delta}$ denote a wedge pertubation 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 $1-\mathcal{T}_{t,t}$, and a permanent wedge $1-\mathcal{T}_{t,t+\infty}$. Consider settings in which at least for the time interval of the pertubation Δ, the other parameters are stable. $\lambda_{it}(1-\mathcal{T}_{t,t+\Delta})$ denotes the (potentially $(1-\mathcal{T}_{t,t+\Delta})$-dependent) budget multiplier. The decision rule for period t employment then is:

$$e^*_{it} = \begin{cases} 0 & \text{if} \quad (1-\mathcal{T}_{t,t+\Delta})y_{it}\lambda_{it}(1-\mathcal{T}_{t,t+\Delta}) < v_{it} \\ 1 & \text{if} \quad (1-\mathcal{T}_{t,t+\Delta})y_{it}\lambda_{it}(1-\mathcal{T}_{t,t+\Delta}) \geq v_{it} \end{cases} \tag{23}$$

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 $1-\tau^*_{t,t+\Delta}$, implicitly defined as the hypothetical prevailing wedge $1-\mathcal{T}_{t,t+\Delta}$ of duration Δ that would leave the worker indifferent between working for that interval $[t, t+\Delta]$ and not working:

$$1-\tau^*_{t,t+\Delta} = \frac{v_{it}}{y_{it}\cdot\lambda_{it}(1-\tau^*_{t,t+\Delta})} \tag{24}$$

Non-Frischian wedges $1-\mathcal{T}_{t,t+\Delta}$ with $\Delta > 0$ have two effects. First, the substitution effect mechanically shifts 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 $\lambda_{it}(1-\mathcal{T}_{t,t+\Delta})$, generally working into the other direction.

Consider an application of our framework to the canonical example of potentially balanced-growth (i.e. $\sigma = 1$) preferences that are separable and iso-elastic in consumption $u(c, h) = \frac{c^{1-\sigma}}{1-\sigma} + v(h)$, and labor income as the only source of income, and with amortized (hence smoothed as consumption) present value of income Y_{it}, for an infinitely-lasting wedge $1 - \mathcal{T}_{t,t+\infty}$:

$$e^*_{it} = \begin{cases} 0 & \text{if} \quad (1 - \mathcal{T}_{t,t+\infty}) y_{it} (1 - \mathcal{T}_{t,t+\infty})^{-\sigma} \cdot Y_{it}^{-\sigma} < v_{it} \\ 1 & \text{if} \quad (1 - \mathcal{T}_{t,t+\infty}) y_{it} (1 - \mathcal{T}_{t,t+\infty})^{-\sigma} \cdot Y_{it}^{-\sigma} \geq v_{it} \end{cases} \tag{25}$$

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*. For the rest of the paper, we focus on the short-run labor supply curve.

Another application of this setting is the reservation wedge of households with borrowing constraints binding and hence hand-to-mouth consuming their (labor) income. This population essentially exhibits static labor supply (although a Frischian experiment can still be induced by leaving income constant due to a lump sum tax transfer T).

Beyond the Spot Market Benchmark Finally, the model accommodates richer considerations in the return to working. For exposition we capture them in terms of an additional term μ_{it} on the incentive side of labor supply, and then review specific examples below:

$$e^*_{it} = \begin{cases} 0 & \text{if} \quad (1 - \mathcal{T}_t) y_{it} \lambda_{it} + \mu^j_{it} < v_{it} \\ 1 & \text{if} \quad (1 - \mathcal{T}_t) y_{it} \lambda_{it} + \mu^j_{it} \geq v_{it} \end{cases} \tag{26}$$

Long-Term Jobs The long-term nature of 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 and at rate 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). Reformulated in terms of wedges, the relevant term augmenting the benefit of the job is the continuation term for a worker considering committing to a long-term job today – of job type y^t_{is} (i.e. job index $j = t$) rather than waiting one period to take a job of type y^{t+1}_{is} (i.e. job index $j = t + 1$), where for simplification we assume that wages are fixed within a job:

$$\mu^{\text{Long-Term Jobs}}_{it} = \sum_{s=t+1}^{\infty} \beta^{s-t} \lambda_{is} (1 - \delta)^{s-t} (1 - \mathcal{T}_s) \left[y^t_{it} - y^{t+1}_{is} \right] \tag{27}$$

An analogous term can be constructed for the separation decision.

Non-Wage Job Amenities Nonwage job amenities (Hall and Mueller, 2018) can either be modeled as μ_{it}^{j} i.e. another job characteristic, or simply be folded into the now *net* disutility of work v_{it}^{j} for each job j, then encompassing all non-monetary flow benefits from the job entering directly the utility function.

Human Capital Accumulation Alternatively, The model can also accommodate incentives to accumulate human capital on the job, as in Imai and Keane (2004) (and also relatedly the skill-loss perspective of Ljungqvist and Sargent (2006, 2008), which we adjust by letting a period's potential earnings $y_{it}\left(\sum_{d=t-T}^{t-1} e_{id}\right)$ depend on the sum of employment in the last T periods. As a result, the spot condition for labor supply includes an μ_{it} term that captures the forward-looking investment incentive for labor supply today.[5]

$$\mu_{it}^{\text{Human Capital}} = \mathbb{E}_t \sum_{s=t+1}^{t+T} (1-\mathcal{T}_s) \left[y_{is}\left(\sum_{d=s-T, d\neq t}^{s} e_{id}^{*} + 1 \right) - y_{is}\left(\sum_{d=s-T, d\neq t}^{s-1} e_{id}^{*} \right) \right] e_{is}^{*} \lambda_{it} \tag{28}$$

The extensive-margin choice and hence reservation wedge definition then follow the general logic.

Frictional vs. Desired Labor Supply: Adjustment Costs and Frictions So for we have characterized *desired* labor supply in form of "gross-of-frictions" reservation wedges.

One can alternatively define a "frictional" labor supply curve, i.e. a "net-of-frictions" reservation wedge distribution that takes into account market structures, such as for the labor market or other markets. In our Frischian context, particularly when zooming into short periods, adjustment frictions may play a role in labor supply behavior (Chetty, Friedman, Olsen, and Pistaferri, 2011; Chetty, 2012).[6] Naturally, a definition respecting these frictions will yield different reservation wedges than one one ignoring those frictions.

To fix ideas, consider the discrete choice setup in which these costs are monetary as an ad-hoc adjustment lump-sum cost $c_{it} < 0$, which my be time- and cross-sectionally varying:[7]

$$\mu_{it}^{\text{Adjustment Cost}}(e_{it-1}) = \lambda_{it} \cdot c_{it} \cdot \mathbb{1}\left(e_{it} \neq e_{i,t-1}\right) \tag{29}$$

For a given transitory shift in the wedge, the presence of such a cost will shrink the set of individuals adjusting, and specifically generate policies – reservation wedges – that differ by previous employment status. As a result, a given employed worker may – gross of frictions – prefer to take off a month for a vacation in response to small wage changes. However, net of the adjustment costs

[5]The original setting of Imai and Keane (2004) presents an hours-based rather than extensive-margin setting, and moreover consider a lifecycle setting. This specific intensive-margin setting could be again be featured with an hours-job choice set (yet would require some nonconvenxities to generate an extensive margin, as discussed previously in the intensive-margin discussion).

[6]The presence of indivisible labor may to some degree arise from adjustment frictions at the intensive margin in the short run, evidence for which is presented in (Chetty, Friedman, Olsen, and Pistaferri, 2011). The distinction between features and frictions is not clear-cut. For example, the skill loss models of Ljungqvist and Sargent (2006) and Ljungqvist and Sargent (2008) are adjustment costs from the perspective of a worker considering temporary nonemployment. Institutional arrangements limiting arbitrarily long and timed "vacations" out of long-term jobs act as adjustment cost.

[7] Direct utility costs could alternatively again be folded into the disutility of employment term v_{it}.

required for transition in and out of nonemployment, the worker may in practice not act on this preference.

3 Meta Study of Models Recast in the Framework

The behavior of aggregate labor supply at the extensive margin in any given model is fully characterized by the reservation wedge distribution. Models will exhibit the same labor supply behavior if and only if they are isomorphic in their reservation wedge distribution. We now present a meta study in which we apply the reservation-wedge approach as a unifying bridge between structurally widely different labor supply blocks, proceeding in three steps:

M1 Construct the individual-level reservation wedge $1-\tau^*_{it}$ in the model at hand.

M2 Compute its equilibrium distribution $F_t(1-\tau^*_{it})$, and plot the implied the aggregate labor supply curve.

M3 Compute the extensive margin labor supply elasticity as $\frac{(1-\mathcal{T}_t)f_t(1-\mathcal{T})}{F_t(1-\mathcal{T}_t)}$.

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).[8] The relevant parameters for our calibrated models in this meta study are in Table 1.

We plot the respective wedge distributions and associated labor supply curves in 1 (a) - (f), and pool all curves in summary Figure 4, the central figure of this section. We report descriptive statistics of the global labor supply curves in Table 2. In Table 3, we report local arc elasticitvies for various intervals around the prevailing aggregate wedge. (We normalize the prevailing aggregate wedge around 1 without loss of generality. This implies that any prevailing taxes in the model are included in the reservation wedge measure, and the relevant wage in the reservation wedge is the after-tax wage.)

3.1 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 $u(c_{it}) - e_{it}v_{it}$ is separable, where $e_{it} \in \{0,1\}$ is an employment indicator. Potential earnings are w_{it}. There is potentially some uncertainty over the path of wages and interest rates, which the household takes as exogenous.

[8] 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). Accordingly, our custom survey targets workers 18 and older without an upper age limit.

The utilitarian household head assigns consumption levels and employment statuses:[9]

$$\max_{\{c_{it},e_{it}\}_i,A_t} \mathbb{E}_0 \sum_{t=0}^{\infty} \int_0^1 \left[u_i(c_{it}) - e_{it}v_{it}\right] g(i)di \tag{30}$$

$$\text{s.t. } A_t + \int_0^1 c_{it}g(i)di \leq A_{t-1}(1+r_{t-1}) + \int_0^1 (1-\mathcal{T}_t)w_{it}e_{it}g(i)di + T_t \tag{31}$$

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

$$\overline{\lambda}_t = \frac{\partial u_i(c_{it})}{\partial c_{it}} \;\; \forall\, i \tag{32}$$

hence eliminating λ_{it} as a source of wedge heterogeneity even if consumption utility $u_i(.)$ differed. Due to the spot nature of jobs, expectations and intertemporal aspects are fully subsumed in $\bar{\lambda}_t$.

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 and nonemployment:

$$1-\tau^*_{it} = \frac{v_{it}}{\overline{\lambda}_t w_{it}} \tag{33}$$

Optimal labor supply assigns each i her employment status $e_{it} \in \{0,1\}$ following the wedge cutoff:

$$e^*_{it} = \begin{cases} 0 & \text{if} \quad 1-\tau^*_{it} > 1-\mathcal{T}_t \\ 1 & \text{if} \quad 1-\tau^*_{it} \leq 1-\mathcal{T}_t \end{cases} \tag{34}$$

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 $1-\tau^*_{it} \leq 1-\mathcal{T}_t$:

$$E_t = F_t(1-\mathcal{T}_t) = P\left(1-\tau_{it} \leq 1-\mathcal{T}\right) = P\left(\frac{v_{it}}{w_{it}\overline{\lambda}_t} \leq 1-\mathcal{T}_t\right) = P\left(\frac{v_{it}}{w_{it}} \leq (1-\mathcal{T}_t)\overline{\lambda}_t\right) \tag{35}$$

$$= \int_{-\infty}^{\infty}\int_{-\infty}^{\infty} \mathbb{1}\left[\frac{v}{w} \leq (1-\mathcal{T}_t)\overline{\lambda}_t\right] dG(v,w) \tag{36}$$

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 $w_{it} = \overline{w}_t$ and $v_{it} = \overline{v} = A\ln(1-h_{it})\forall i$, with one, exogenous

[9] We take a perspective, akin to Gali (2015), that the household head directly determines employment allocations. In Hansen (1985) and Rogerson (1988), employment can be assigned 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 $\overline{\lambda}_t\overline{w}_t = \overline{v}$.

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:

$$1 - \tau_{it}^* = 1 - \overline{\tau}_t^* = \frac{\overline{v}}{\overline{\lambda}_t \overline{w}_t} \tag{37}$$

Second, the wedge distribution, plotted in Figure 1 (a) is degenerate.

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

Heterogeneity Only in Disutility of Labor We now shut off heterogeneity in wages and only allow heterogeneity in the disutility of labor v distributed according to CDF $G^v(v)$: Now, the household maximizes:

$$\max_{\{c_{it}, e_{it}\}, A_t} \mathbb{E}_0 \sum_{t=0}^{\infty} \int \left[u_i(c_{it}) - e_{it} v_{it} \right] g(i) di \tag{38}$$

$$\text{s.t. } A_t + \int_0^1 c_{it} g(i) di \leq A_{t-1}(1 + r_{t-1}) + (1 - \mathcal{T}_t) w_t \int e_{it} g(i) di + T_t \tag{39}$$

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

$$1 - \tau_{it}^* = \frac{v_{it}}{\overline{w}_t \overline{\lambda}_t} \tag{40}$$

$$= 1 - \tau_{vt}^* \tag{41}$$

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

$$E_t = F_t(1 - \mathcal{T}_t) = P\left(1 - \tau_{it}^* \leq 1 - \mathcal{T}_t\right) = P\left(v_{it} \leq \frac{1 - \mathcal{T}_t}{\overline{w}_t \overline{\lambda}_t}\right) = G^v\left(\frac{1 - \mathcal{T}_t}{\overline{w}_t \overline{\lambda}_t}\right) \tag{42}$$

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

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

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:

$$\frac{C_t^{1-\sigma}}{1 - \sigma} - \Psi \frac{E_t^{1+1/\eta}}{1 + 1/\eta} \tag{43}$$

We now *reverse-engineer* a distribution of disutility $G^v(v)$ that delivers this labor supply specification. The micro wedge is again given by (40). Suppose v follows a power distribution $G^v(v) = \left(\frac{v}{v_{\max}}\right)^{\alpha_v}$ with shape parameter α_v over support $[0, v_{\max}]$. Then, aggregate employment is (where, building on Section 2, assuming positive nonemployment by all types):

$$E_t = F_t(1-\mathcal{T}_t) = P\left(\frac{v_{it}}{\overline{w}_t\overline{\lambda}_t} \leq 1-\mathcal{T}_t\right) = G^v\left((1-\mathcal{T}_t)\overline{w}_t\overline{\lambda}_t\right) = \left(\frac{(1-\mathcal{T}_t)\overline{w}_t\overline{\lambda}_t}{v_{\max}}\right)^{\alpha_v} \tag{44}$$

The wedge distribution then too is a power distribution inheriting shape parameter α_v – giving the constant extensive margin Frisch elasticity:[10]

$$\epsilon_{E_t,1-\mathcal{T}_t} = \frac{(1-\mathcal{T}_t)F_t(1-\mathcal{T}_t)}{F_t(1-\mathcal{T}_t)} = \frac{(1-\mathcal{T}_t)\alpha_v(1-\mathcal{T}_t)^{-1}\left(\frac{(1-\mathcal{T}_t)\overline{w}_t\overline{\lambda}_t}{v_{\max}}\right)^{\alpha_v}}{\left(\frac{(1-\mathcal{T}_t)\overline{w}_t\overline{\lambda}_t}{v_{\max}}\right)^{\alpha_v}} = \alpha_v \tag{46}$$

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 (44):

$$v_{\max}E_t^{\frac{1}{\alpha_v}} = (1-\mathcal{T}_t)\overline{w}_t\overline{\lambda}_t \tag{47}$$

which is the first order condition of objective function (43) for $\eta = \alpha_v$ and $\Psi = v_{\max}$.

In Figure 1 (b), we plots the density of reservation wedges for a MaCurdy model with the wage $\bar{w}$ and marginal utility of consumption $\bar{\lambda}$ 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 accommodates wage heterogeneity. Individuals are a unit square indexed by $(j,s) \in [0,1]\times[0,1]$. j denotes the type of labor, paid wage w_{jt}, which may diverge across types

[10] The first alternative is: suppose the head sends $E_t \in [0,1]$ members to work, optimally sorted by their disutility of labor through disutility $v(E_t)$. From (44), the cumulative disutility of these E_t workers is:

$$\int_0^{v(E_t)} v dG^v(v) = \frac{\alpha_v}{{v_{\max}}^{\alpha_v}}\int_0^{v(E_t)}(v)^{\alpha_v}dv = \frac{\alpha_v}{{v_{\max}}^{\alpha_v}}\frac{v^{1+\alpha_v}}{1+\alpha_v}\Bigg|_0^{v(E_t)} = v_{\max}\frac{E_t^{1+1/\alpha_v}}{1+1/\alpha_v} \tag{45}$$

which again mirrors MaCurdy utility function (43) for $\eta = \alpha_v$ and $\Psi = \overline{v}$. Second, "skipping" reservation wedges, one starts from $E_t = G(v_t^*)$. If v_{it} is likewise power-distributed with CDF $G(v) = \left(\frac{v}{v_{\max}}\right)^{\alpha_v}$ over support $[0, v_{\max}]$, the elasticity is $\epsilon_{E_t,(1-\mathcal{T}_t)} = \frac{1-\mathcal{T}_t}{G(v_t^*)}g(v_t^*) = \alpha_v v^*\left(\frac{(v^*)^{\alpha_v-1}}{\overline{v}^{\alpha_v}}\right)/\left(\frac{v^*}{v_{\max}}\right)^{\alpha_v} = \alpha_v$.

due to wage stickiness. s indexes labor disutility, s^{ϕ}. The household head maximizes:

$$\max_{c_t,\{E_{jt}\}} \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^{t-s} \Big(\frac{c_t^{1-\sigma}-1}{1-\sigma} - \chi \int_0^1 \overbrace{\int_0^{E_{jt}} s^{\phi}\, ds}^{\frac{E_{jt}^{1+\phi}}{1+\phi}} dj \Big) \tag{48}$$

$$\text{s.t. } A_t + \int_0^1 c_{jt} dj \leq A_{t-1}(1+r_{t-1}) + (1-\mathcal{T}_t) w_{jt} E_{jt} + T_t \tag{49}$$

where j-specific total employment is $E_{jt} = \int_0^1 e_{jt} dj$.

First, to cast in our framework, we define the micro reservation wedge. An individual i is fully characterized by her type $(j,s)(i)$:

$$1 - \tau^*_{sjt} = \frac{\chi s^{\phi}}{w_{jt}\overline{\lambda}_t} \tag{50}$$

Second, the distribution of $1-\tau^*_{sjt}$ is (building on Section 2, assuming *some* nonemployment within each *wage*-type j):

$$F_t(1-\mathcal{T}_t) = P\left(\frac{\chi s^{\phi}}{w_{jt}\overline{\lambda}_t} \leq 1-\mathcal{T}_t\right) = \int_0^1 \left(\frac{(1-\mathcal{T}_t) w_{jt}\overline{\lambda}_t}{\chi}\right)^{1/\phi} dj = \left(\frac{(1-\mathcal{T}_t)}{\chi \Big/ \left(\left(\int_0^1 w_{jt}^{1/\phi} dj\right)^{\phi} \overline{\lambda}_t\right)}\right)^{1/\phi} \tag{51}$$

which is a power distribution with maximum $\chi\left(\left(\int_0^1 {w_{jt}}^{1/\phi} dj\right)^{\phi} \overline{\lambda}_t\right)$ and shape parameter $1/\phi$.

Third, again as in Section 2 the elasticity is again precisely ϕ.[11]

3.2 Heterogeneous Agent Models: Atomistic Households Without Risk Sharing

We now move to heterogeneous agent models, where atomistic households make labor supply and consumption decisions individually with separate budget constraints. In these class of models, heterogeneity in skills, asset endowments or tastes can generate heterogeneity in λ_{it}.

A useful classification of heterogeneity, for a given object, is whether it is permanent or transi-

[11] Intuitively, the distribution of the reservation wedge is power-distributed with the same parameter within each labor type. As a result, changes in $1-\mathcal{T}_t$ elicit the same proportional employment changes from each labor type, and the aggregate employment elasticity inherits that homogeneous elasticity. Our expression holds for $1-\mathcal{T}_t$ small enough that $1-\tau^*_{s,j,t} > 1-\mathcal{T}_t$ holds for some s within *all* labor types j, 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 $1/\phi$, and the CDF (labor supply curve) is:

$$F_t(1-\mathcal{T}_t) = P\left(s \leq \left(\frac{(1-\mathcal{T}_t) w_{jt}\overline{\lambda}_t}{\chi}\right)^{1/\phi}\right) = \int_0^1 \min\left\{\left(\frac{(1-\mathcal{T}_t) w_{jt}\overline{\lambda}_t}{\chi}\right)^{1/\phi}, 1\right\} dj \tag{52}$$

tory.

3.2.1 Permanent Heterogeneity

We start with a note showing that permanent heterogeneity. Consider a household that may differ in disutility v_i, initial endowments a_{0i}, or wages w_i (or consumption tastes $u_i(c_{it})$), with stable interest rates $r = \rho$ and no borrowing constraint, such that we obtain a simple lifecycle budget constraint:

$$\max_{c_t, e_t, a_t} \mathbb{E}_0 \int_{t=0}^{\infty} e^{-\rho t} \left[u_i(c_{it}) - v_i e_{it} \right] dt \tag{53}$$

$$\text{s.t.} \quad \dot{a}_{it} = (1 - \mathcal{T}_t) w_i e_{it} + r a_{it} - c_{it} + \mathbb{1}(t = 0) \cdot a_{0i} \forall t \tag{54}$$

$$\Leftrightarrow \int_{t=0}^{\infty} e^{-rt} c_{it} dt = \int_{t=0}^{\infty} e^{-rt} (1 - \mathcal{T}_t) w_i e_{it} dt + a_{0i} \tag{55}$$

First, this household's labor supply choice is an employment policy e^*_{it} characterized by a *constant* reservation wedge:

$$1 - \tau^*_{it} = \frac{v_i}{\lambda_i w_i} \tag{56}$$

$$= 1 - \tau^*_i \tag{57}$$

Second, we move to the distribution of the wedges (labor supply curve):

$$F(1 - \mathcal{T}_t) = \int_i \mathbb{1}[1 - \tau^*_i \leq 1 - \mathcal{T}_t] g(i) di \tag{58}$$

The constant wedge structure implies that for a given prevailing wedge $1 - \mathcal{T}_t$, there are three regions of parameter spaces. 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 set of marginal workers, who 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.

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

We therefore move to more realistic models with time-varying heterogeneity below, starting with the stochastic wages case in Section 3.2.2, and then moving to deterministic age profiles in wages in Section 3.3

3.2.2 Time-Varying Heterogeneity: Stochastic Wages (Huggett, 1993)

Below, we consider the popular case where the deep heterogeneity between households arises from stochastic shocks to wages (productivity). Importantly, the model features incomplete financial markets, such that wage realizations pass through into the budget. Specifically, the households can only borrow and save in one asset, and moreover potentially face a borrowing constraint. As a result, wage realizations shift income and wealth, to which consumption/savings policies respond, resulting in heterogeneity in assets, consumption, and λ_{it}.

Specifically, we introduce an extensive-margin choice into the model of Huggett (1993). There is a continuum of individuals, heterogeneous in net assets holdings a, which earn interest r, and potential earnings w. The individual's labor supply choice is limited to either working or not working; that is, $e_t \in \{0, 1\}$. Earnings, conditional on working ($e_t = 1$) follow an exogenous Markov process, and the individual receives unemployment benefit level b if the individual does not work ($e_t = 0$). The household maximizes separable preferences, subject to budget constraint and borrowing limit $\underline{a} < 0$, with discount factor $\beta \leq 1$:

$$\max_{c_t, e_t, a_t} \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left[\frac{c_t^{1-\sigma}}{1-\sigma} - \overline{v} e_t \right] \tag{59}$$

$$\text{s.t.} \quad a_{t+1} = (1 - \mathcal{T}_t) w_t e_t + b(1 - e_t) + (1 + r_t) a_t - c_t \tag{60}$$

$$a_t \geq \underline{a} \tag{61}$$

Computationally, we solve the model in continuous time using the methods from Achdou, Han, Lasry, Lions, and Moll (2017). We relegate computational details to Appendix Section C.2).

Once the model is solved, we calculate each individual's reservation wedge, our first step. Individuals can be indexed by their types, defined by assets a and potential wage w:

$$1 - \tau^*_{aw} = \frac{\overline{v}}{\lambda_{aw}(w - b)} \tag{62}$$

Second, we calculate and plot the wedge distributions and CDFs (labor supply curves):

$$F(1 - \mathcal{T}) = \sum_{w \in W} \int_{\underline{a}}^{\infty} \mathbb{1}[1 - \tau^*_{a,w} \leq 1 - \mathcal{T}] g(a, w) da \tag{63}$$

where $g(a, w)$ is the equilibrium density of individuals with asset level a and potential wage w.

Two-State Income Process We start with a two-level Markov process for potential earnings, jumping from w_1 to $w_2 > w_1$ (w_2 to w_1) at rate λ_{12} (λ_{21}). Our goal is to illustrate that the aggregate extensive margin labor dynamics quickly become complex already with only two wage states –

and how our framework can help make sense of an otherwise obscure labor supply curve. The parameters (reported in Table 1) are not picked to match any empirical moments, except for the equilibrium employment rate is equal to 60.7% when $1-\mathcal{T}_t = 1$.

Appendix Figure A1 plots the reservation wedge as a function of assets, separately by wage. For both wage levels, $1-\tau^*_{a,w}$ is increasing in assets, since $\lambda_{a,w} = c^{*-\sigma}_{a,w}$ is decreasing in assets. As expected, $1-\tau^*_{a,w_2} < 1-\tau^*_{a,w_1}$ for any given asset level a, since higher wages raise consumption and the the opportunity cost of not working. For $1-\mathcal{T}_t = 1$, all high earners work, regardless of their asset holdings ($1-\tau^*_{a,w_2} < 1 \forall a \geq \bar{a}$). Low earners work if assets (and consumption) are low, but above an asset threshold $a^*_{w_1}$ s.t. $1-\tau^*_{a,w_1} = 1$ prefer nonemployment.

We plot the distribution of the wedges in Figure 1 (e). The implied labor supply curve exhibits complex behavior even with only two wage types, due to the asset distribution. When the labor wedge is at $1-\mathcal{T}_t = 1$, the marginal worker is a low-wage worker with a relatively high asset level. As $1-\mathcal{T}_t$ 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 $1-\mathcal{T}_t$ falls further, all low-wage individuals become nonemployed, and the marginal worker is now the high-income earners.

[in progress] Nine-State Income Process Matching Empirical Earnings Processes (Guvenen, Karahan, Ozkan, and Song, 2015) We now consider a 9-state income process following the earnings process in Guvenen, Karahan, Ozkan, and Song (2015) as e.g. in Kaplan, Moll, and Violante (2018), now attempting to model a realistic income process.

The Role of Incomplete Financial Markets The model features heterogeneity in λ for two reasons. First, if agents were "born" in heterogeneous states, they would differ in their wealth. Second, even if agents were all born in the initial state, the heterogeneous evolution of wages would generate wealth and income realizations that would shift λ. That link crucially relies on incomplete markets: if (risk-averse) agents could hedge their income risk by trading income-state contingent claims, they would undo the wealth implications of the Markov process, generating homogeneity in λ despite the stochastic evolution of income. That is, complete markets generate an economy that mimics the large representative full-insurance household despite heterogeneous (yet time-varying) wage distributions.

3.3 Intensive and Extensive Margins, and Lifecycle Dynamics

Rogerson and Wallenius (2008) As laid out in the general case in Section 2, allowing for intensive margin hours choices preserves the reservation wedge framework. A leading model that incorporates an intensive margin choice and delivers extensive margin movements is Rogerson and Wallenius (2008) (RW), which also features rich lifecycle patterns. We discuss our solution to the RW model and our choice of parameters in Appendix Section C.1.

The overlapping generations economy has a unit mass of individuals born at every instant, who live between age $a \in [0,1]$. Wages w_a are age-specific, generating lifecycle aspects. (In the RW model, the wage will be a triangular, single-peaked function of age.) Individuals choose consumption, whether to work, and the numbers of work hours:

$$\max_{c_a,h_a} \int_{a=0}^{1} e^{-\rho a} \left[u(c_a) - v(h_a)\right] da \tag{64}$$

$$\text{s.t.} \int_{a=0}^{1} e^{-ra} c_a = \int_{0}^{1} e^{-ra} y_a(h) da \tag{65}$$

Disutility is MaCurdy at the intensive margin, with $v(h_a) = \Gamma \frac{h_a^{1+1/\gamma}}{1+1/\gamma}$.

The extensive margin choice in this model arises from a nonconvexity in form of fixed hours cost, such that only labor hours above $\underline{h}$ are productive and earn wage w_a:

$$y_a(h_a) = w_a \max\{h_a - \underline{h}, 0\} \tag{66}$$

In the absence of this fixed cost, the marginal disutility from working at $h = 0$ hours is zero, and so all individuals would work strictly positive hours, regardless of age as long as wages are positive – eliminating the extensive margin as in the intensive-margin job choice in Section 2.3.

First, we define the individual-level reservation wedge, here specified for an individual at age a, implicitly defined as a fixed point, as in our general job-choice case in Section 2.3. 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. In our simulation, the consumption part of the utility function is CRRA. $h_a^*(1-\mathcal{T})$, the intensive margin choice at age a given wedge $1-\mathcal{T}$, is given by $(1-\mathcal{T})w_a = \Gamma h_a^{*1/\gamma}$. In the RW model, we can then solve for the age-specific reservation wedge explicitly:

$$1 - \tau_a^* = \frac{v(h_a^*(1-\tau_a^*)}{\lambda_a y_a(h_a^*(1-\tau_a^*))} = \frac{v\left(\left[\frac{(1-\tau_a)w_a}{\Gamma}\right]^{\gamma}\right)}{w_a\left(\left[\frac{(1-\tau_a)w_a}{\Gamma}\right]^{\gamma} - \underline{h}\right)} = \frac{\Gamma\left(\underline{h}(1/\gamma+1)\right)^{1/\gamma}}{w_a} \tag{67}$$

The only time-varying element of the wedge is the wage: households work when the wage is above threshold w^*. Also, setting $\underline{h} = 0$ nests the MaCurdy intensive-margin-only setting, with $1 - \tau_a^* = 0$ for all workers and ages.

Second, in Figure 1 (e) and (f) we again plot the distribution of reservation wedges, and trace out the aggregate labor supply curve:

$$F(1-\mathcal{T}) = P\left(\frac{\Gamma\left(\underline{h}(1/\gamma+1)\right)^{1/\gamma}}{w_a} \leq 1-\mathcal{T}\right) = P\left(\frac{1}{w_a} \leq \frac{1-\mathcal{T}}{\Gamma\left(\underline{h}(1/\gamma+1)\right)^{1/\gamma}}\right) \tag{68}$$

clarifying that here the wedge distribution inherits that of $1/w_a$. If $1/w_a$ were power-distributed, the RW model would again exhibit a constant Frisch elasticity. In the RW model, w_a is piece-wise linear (a single-peaked triangle in age), so the wage distribution is given by the age distribution.

Third, we compute the aggregate extensive-margin elasticity. We then numerically approximate the local densitity using the simulated discretized distribution of $1-\tau_a^*$ (details in Appendix C.1), from which we calculate the Frisch elasticity, which is 2.87. In principle, the reservation wedge distribution would permit us to obtain the elasticity analytically.[12]

The Role of the Intensive Margin Figure 1 (f) additionally plots as a dashed line the labor supply curve 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 weakly raises the return of work. As a result, the flexible-hours extensive employment curve always exceeds the fixed-hours analogue.

4 Empirical Reservation Wedges

Having robustly formulated the extensive-margin aggregate labor supply curve as the reservation wedge distribution, the natural next object of interest is the shape of the empirical analogue. We next show that the reservation wedge can be directly measured in household survey data, permitting us to construct the empirical curve. We implement this reservation wedge elicitation by running a custom survey in the United States. We thereby follow the empirical analogous of our three model steps:

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

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

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

We complement this tailored survey with an additional covariate analysis in larger and more conventional household surveys by showing that the wedge can alternatively be constructed as the individual's ratio of her reservation wage to her actual/potential wage. These samples are restricted to the unemployed, yet permit us to conduct richer panel investigations and further assess the micro determinants of the wedges.

[12] Our method complements the construction of the RW model's Frisch elasticity by Chetty, Guren, Manoli, and Weber (2012), who simulate a small, short-lived once percentage-point tax change in the calibrated RW model. (They then compare the model output to empirical Frisch-like quasi-experiments (an income tax holiday (studied in Bianchi, Gudmundsson, and Zoega, 2001) and targeted tax incentives to work (Meyer, 2010; Card and Hyslop, 2005).) While a short-lived tax change may affect consumption, our method isolates a strict Frisch elasticity. Besides permitting visualization and characterization of the full curve, it is perhaps also much simpler to numerically approximate the wedge distribution than to simulate a temporary tax change, which requires repeatedly solving the model for each generation.

4.1 Measuring the 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. To enlarge our sample size for a covariate analysis and exploit a larger panel structure, we supplement this analysis with a series of existing larger surveys limited to unemployed workers and show how reservation wage (rather than wedge) questions can be constructed into wedge proxies.

4.1.1 Custom Survey of U.S. Households

Data: Custom Reservation Wedge Survey We implement this approach with a tailored survey question in a nationally representative U.S. survey of [first wave: 1,000; additional waves coming] respondents. Our survey was then fielded by NORC (University of Chicago), in a sample drawn from the AmeriSpeak Omnibus 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 analysis.

Ideal Measure of the Reservation Wedge To fix ideas, we start with the ideal measure, and then clarify how we implement this question in the survey. The ideal survey question closely mirrors its formal theoretical definition, for the employed [nonemployed] worker and hence abstracts from potential frictions in such choices to elicit *desired* labor supply:

> You are currently [non-]employed. Suppose the following thought experiment: you (and only you) receive a 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 not working for this period and working (at whichever job would be your best choice at that given tax [subsidy] rate)?

By invoking an additional tax on top of a potentially prevailing one $(1-\hat{\tau}^*_{it})(1-\mathcal{T}_t)$, the answer would also automatically targets one as the cutoff for the marginal worker (i.e. is centered around one), and hence does not require a stance on empirical prevailing wedges $\mathcal{T}_t$:

$$(1-\hat{\tau}^*_{it})(1-\mathcal{T}_t)y_{it}\lambda_{it} = v_{it} \tag{69}$$

$$\Leftrightarrow 1-\hat{\tau}^*_{it} = \frac{v_{it}}{(1-\mathcal{T}_t)y_{it}\lambda_{it}} \tag{70}$$

$$= \frac{1-\tau^*_{it}}{1-\mathcal{T}_t} \tag{71}$$

Our design differs from the reservation wage questions that have long been asked to *unemployed* searchers. First, one innovation of our question is to elicit it from all three labor force segments of the population. Second, we ask about percent shifts in wages rendering the individual marginal. Third, we explicitly focus on a Frischian neoclassical setting rather than a sequential search model with long-term jobs. Fourth, the ideal question permits job switching and reoptimization (see Section 2.3).

In practice, we translate this ideal questions into three variants, routed by labor force status.[13] Given that we are to our knowledge the first to elicit the reservation wage/wedge off non-job-searchers, we present our three questions below. These questions are results of prolonoged piloting, leading us to formulate rather concrete scenarios. Throughout, we keep the frequency of the Frischian wage change constant at one month. Feedback from our pilots also led us to present a "job-constant" perspective (at the prevailing wage), rather than explicitly alluding to the possibility of job switching or hours adjustments. The wedge we elicit in practice is therefore:

$$(1-\widetilde{\widetilde{\tau}}^*_{it})(1-\mathcal{T}_t)y_{it,1-\mathcal{T}_t}\lambda_{it} \equiv v_{it,1-\mathcal{T}_t} \tag{72}$$

$$\Leftrightarrow 1-\widetilde{\widetilde{\tau}}^*_{it} = \frac{v_{it,1-\mathcal{T}_t}}{(1-\mathcal{T}_t)\lambda_{it}y_{it,1-\mathcal{T}_t}} \tag{73}$$

$$= \frac{1-\tilde{\tau}^*_{it}}{1-\mathcal{T}_t} \tag{74}$$

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.

[13] We feature an additional variant of the question for the temporarily laid of. We do not ask the self-employed, given the missing wage concept. We do not differentiate between multiple-job holders.

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 The out of the labor force presented the most significant challenge in our surveying. They are the ones least likely to consider a scenario of taking up employment, in some cases perhaps containing the disabled or those without possibility of employment. Yet of course there are marginal workers in this set, given the fluctuations in the labor force participation rate as well as individual-level transitions in and out of this state. Ex ante we naturally do not know how many and who of the out of the labor force are at the margin, hence we ask the question of all out of the labor force, while explicitly warning this sample about the hypothetical nature of the experiment. We also highlight the possibility to respond with a very high number if the respondent finds an employment scenario unappealing even at a high wage. Another distinction is that we here require a *subsidy* 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. We implement this scenario with the most concrete and plausible real-world scenario, in 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.

4.1.2 Supplementary Data: Proxies from Reservation Wage Household Surveys

Additional Proxy: Reservation/Potential Wage Ratios We complement our tailored survey with a 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-$\mathcal{T}$ reservation wage (earnings) y^r_{it} (for indifference between employment and nonemployment for a short period of time, all else equal), by:

$$(1-\mathcal{T}_t)y^r_{it,j(1-\mathcal{T}_t)}\lambda_{it} = v_{it,1-\mathcal{T}_t} \tag{75}$$

$$\Leftrightarrow y^r_{it,1-\mathcal{T}_t} = \frac{v_{it,1-\mathcal{T}_t}}{(1-\mathcal{T}_t)\lambda_{it}} \tag{76}$$

This route requires characterizing the worker's actual or potential earnings $y_{it,1-\mathcal{T}_t}$. We can write the reservation wedge as reservation-to-actual/potential-wage ratio, again centered around one and hence mirroring the $(1-\hat{\tau}^*_{it})(1-\mathcal{T}_t)$ analogue of the model object as in the aforementioned direct wedge question:

$$\Rightarrow \frac{y^r_{it,1-\mathcal{T}_t}}{y_{it,1-\mathcal{T}_t}} = \frac{\frac{v_{it,1-\mathcal{T}_t}}{(1-\mathcal{T}_t)\lambda_{it}}}{y_{it,1-\mathcal{T}_t}} \tag{77}$$

$$= \frac{1-\tilde{\tau}^*_{it}}{1-\mathcal{T}_t} \tag{78}$$

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

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.

Administrative Data from UI Agency We have obtained the within-worker ratios of micro data collected by the French UI administration (government employment agency) Pôle empoi. The data are binned histograms; we therefore include this data set in the distributional analysis yet cannot provide a covariate analysis.[14] The data cover all UI claimants in France, a context of high UI take-up, and besides requiring reservation wage information and registration. Our potential wage proxy is the last job's wage (specifically the data set comes as the worker-level reservation to lagged wage ratio). By sampling unemployment entrants, this unique data source likely captures marginal workers or inframarginal workers who themselves or whose jobs have been hit with negative surplus shocks. Since the information on the worker's potential wage in our setting is the previous wage, that wage may not reflect the potential reemployment wage.

GSOEP Household Panel Survey The German Socioeconomic Panel (GSOEP) is a long household panel survey. It also elicits reservation wages from unemployed respondents. Unlike the French data, the GSOEP reservation wage question is not just asked at unemployment entry but at the given survey date, hence perhaps less subject to anchoring at the previous wage. We also have

[14] We thank the authors of Le Barbanchon, Rathelot, and Roulet (2017) for providing us with the binned data.

detailed labor market and other characteristics from this rich panel survey. Our potential wage proxy 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) and nonemployed (both current searchers and non-searchers that previously searched). Among the nonemployed, it asks the current searchers (unemployed) as well as those not searching but who state they previously did search.

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.

4.2 Results: The Empirical Aggregate Labor Supply Curve

Histograms of the Reservation Wedge We present histograms of the empirical reservation wedges from the reported reservation wedges in the NORC survey data in Figure 2.

Aggregate Labor Supply Curves We complement the histogram with raw data tracing out the implied extensive-margin short-run labor supply curve. As in the model meta study, we aggregate the micro wedges into a cumulative distribution function. To facilitate visual inspection with regards to implied elasticities, we take logs of both axes, thereby plotting desired $\log(E^*)$ against $\log(1-\mathcal{T})$. The aggregate labor supply curve constructed using the NORC survey data is in Figure 2.

We report descriptive statistics of the global labor supply curves in Table 2. In Table 3, we report local arc elasticitvies for various intervals around the prevailing aggregate wedge. (We normalize the prevailing aggregate wedge around 1 without loss of generality. This implies that any prevailing taxes in the model are included in the reservation wedge measure, and the relevant wage in the reservation wedge is the after-tax wage.)

Implied Elasticities The empirical labor supply curve exhibits elasticities given by (8):

$$\epsilon_{E,(1-\mathcal{T})\to(1-\mathcal{T}')} = \frac{F\left(1-\mathcal{T}'\right)-F\left(1-\mathcal{T}\right)}{F\left(1-\mathcal{T}\right)} \Bigg/ \frac{\left(1-\mathcal{T}\right)-\left(1-\mathcal{T}\right)}{1-\mathcal{T}}$$

We also formally estimate which *constant* elasticity would be implied by the data. In Section 2 we showed that a constant extensive-margin Frisch elasticities require a power law distribution, where the shape parameter (α) represents that elasticity. We could test whether the empirical curve is power-distributed, and estimate the best-fit $\hat{\alpha}$.[15]

Relation of Reservation Wedge to Covariates In Figure 6 panels (b), (d), and (f), we portray different cuts of the reservation wedge distribution, by gender, parternship status, and age. In the U.S. population, the reservation wedge distribution of men appears to have more mass around 1.0 than that of women. The reservation wedges of individuals living with partners appears has more mass underneath one than that of non-partnered respondents. Age does not appear to be associated with differences in the reservation wedges for primeage respondents; however, the reservation wedges are higher for older individuals, since a larger proportion of these respondents are out of the labor force.

Proxied Wedge Distributions from the Supplementary Surveys of the Unemployed We present histograms of the empirical reservation wedges from Pole Emploi and GSOEP in Figure 3, respectively. For clarity, we provide key moments of the distribution of reservation wedges in Table **??**. 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). 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 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

[15] The MLE estimator for a shape parameter $\gamma > 0$ for a given standard power law distribution $F(X) = P(x < X) = a \cdot \left(\frac{x}{X_{\min}}\right)^{-\gamma+1}$, and hence for iso-elasticity parameter $\alpha = \gamma - 1$, is given by:

$$\hat{\gamma} = 1 + n\left[\sum_{i}^{n} \ln\left(\frac{\frac{1}{1-\tau^*}}{\frac{1}{(1-\tau^*)_{\max}}}\right)\right]^{-1} \tag{79}$$

$$\Rightarrow \hat{\alpha} = n\left[\sum_{i}^{n} \ln\left(\frac{\frac{1}{1-\tau^*}}{\frac{1}{(1-\tau^*)_{\max}}}\right)\right]^{-1} \tag{80}$$

where n is the number of observations, $i \leq n$ indexes our data points. The standard error of $\hat{\gamma}$ is given by $SE_{\gamma} = \frac{\hat{\gamma}-1}{\sqrt{n}}$, hence the standard error of the iso-elasticity parameter is $SE_{\alpha} = \frac{\hat{\alpha}}{\sqrt{n}}$.

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 in the potential wage, unemployed job seekers should have a reservation wedge lower than one (otherwise should not be searching). Measurement error likely plays a role in the GSOEP and Pole Emploi, where the past wage serves as our measure of the unemployed respondent's potential wage.

Still, overall and bunching around one aside, this provides a clear group of people whom one might designate as marginal workers according to the reservation wedge formulation. The distribution is dispersed below one, indicating a clear majority set of very inframarginal workers that gain positive surplus from employment.

4.3 Covariates of the Wedge

We next present a covariate analysis of the empirical reservation wedges. The first purpose is to validate the use of our reservation wedge proxy. The second is to shed light on the covariates of marginal and inframarginal workers, and what the distribution of worker surplus is by subsample.[16] Third, one could assess the empirical against theoretical covariates model-by-model.

As a way of parsimoniously illustrating the raw relationships between various covariates, we regress the logged reservation wedge on various covariates in Tables 5 (our U.S. survey) 6 (German GSOEP). We conduct more covariate-by-covariate regressions (incl. baseline controls) and then one kitchen-sink multivariate regression in the last column.

Age The RW model implies 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. We therefore plot the GSOEP data age profile of the reservation wedge in Figure 6 (e). We also include the sample employment rate gradient (of all respondents in the data), which exhibits the standard inverse-U shape. The average reservation wedge proxy of younger workers (aged 20 to 25) is higher than that of older workers, consistent with these workers having lower productivity (as in the RW model) or having higher-valued non-work outside options such as schooling. Interestingly, *older* workers' reservation wedge proxies are nearly flat and finally falls – inconsistent with the RW prediction.

We repeat this with the NORC data as well in Figure 6 (f). Since our NORC sample is significantly smaller, we are not able to compare it directly to the GSOEP data. For one, we bin ages to the nearest multiple of five. Second, GSOEP elicits reservation wages from unemployed workers only, while we have reservation wedges from adults in any of the labor force statuses. However, this means we only have a few dozen unemployed workers in our sample.

The relationship between age and the reservation wedge is strikingly different in this graph, due to the different sample. Before age 60, the relationship is flat, but then reservation wedges

[16] 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.

increase after age 60. This is almost entirely due to the change in labor force status after age 60, when more of the sample leaves the labor force, and so their reservation wedges are naturally (and, by construction in the survey) higher than either the employed or unemployed, which dominate the under-60 sample.

Sex We check whether male and female workers exhibit different wedges in the data. Reservation wedges of male and female workers are very similar among GSOEP respondents, with mean male reservation wedges of 0.845 and mean female reservation wedges of 0.850. That statistic masks interesting differences in other moments, as the histogram of wedges by sex in Figure 6 (a) reveals. Specifically, 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.

Household Structure We compare reservation wedges of households with different family structures using information on whether or not the respondent is "partnered" (i.e. either in a registered same-sex relationship or married) or has children. *A priori*, it is unclear whether or not partnership or having children should be associated with higher or lower reservation wedges. On one hand, a larger number of household members, keeping household income constant, could increase the marginal utility of consumption relative to a single-person household. On the other hand, a household with two income earners could provide some consumption insurance to an unemployed partner, lowering the marginal utility of consumption. As for the disutility of labor, having children in the household could increase the disutility of working as time spent at home becomes more valuable (through either home production or leisure).

Figure 6 (c) presents the histograms of the reservation wedge proxy, by partnership status. Partnered individuals exhibit lower reservation wedges. The distribution of partnered workers' reservation wedge proxies is shifted to the left relative to that of non-partnered individuals, with more of the mass of reservation wedges for this sub-group in the area less than 1. This is consistent with partnership increasing the marginal utility of consumption of the household. According to the regression results in Table 6 columns 2 and 7, having children does not appear to be associated with higher or lower reservation wedges, even controlling for other covariates. This suggests that the presence of children could have offsetting effects on the reservation wedge by increasing both the marginal utility of consumption and the value of time spent at home.

The Opportunity Cost of Working The labor disutility term in the reservation wedge formulation represents any utility cost of employment. While we cannot observe this measure directly in the data, the GSOEP asks respondents to rate their satisfaction of housework and leisure on a zero to ten scale.[17] Higher levels of satisfaction with household and leisure are associated with lower reservation wedges, which is consistent with an interpretation of "high satisfaction" as someone for whom additional leisure or housework time has low value. Under the reservation wedge formulation, this would be associated as a low disutility of labor, and a lower reservation wedge.

[17]We split these into three bins, with "low" satisfaction comprising responses 0-4, "medium" satisfaction comprising responses 5-7, and "high" satisfaction comprising responses 8-10.

Wealth, Borrowing Constraints, and Financial Stability While the GSOEP Core sample provides little direct data on the finances of respondents (other than income in the current and previous year), the survey does ask how concerned respondents are about their financial situation. Specifically, the survey asks how satisfied the respondent is with their household's income (on a 0 to 10 scale, which we again bin into low, medium, and high concern) and how concerned the respondents are about their financial situation (little concern, somewhat concerned, or very concerned). Perhaps counterintuitively, satisfaction with income is negatively associated with the reservation wedge, while concern about ones' finances is positively associated with the reservation wedge. [In progress: We will probe these results further by experimenting with the expected rather than lagged wage, and with lagged versions of the concerns question (rather than contemporaneous and hence post-separation, while-unemployed snapshots).]

Education Basic theories of human capital enhancing market productivity would predict worker surplus to increase in education (e.g., Oi, 1962). In Figure A2, we plot average reservation wedges and employment rates, by education level. As would be consistent with educated individuals having job options with higher wages, the employment rate of highly-educated individuals is higher and the ratio of the reservation wages to lagged wages is lower.

5 Comparing Empirical and Model-Implied Reservation Wedge Distributions

5.1 Aggregate Labor Supply Curves: Model vs. Data

The reservation wedge distribution interrelates in a unifying framework not only between labor supply blocks of various models, but also serves as a bridge between the empirical as well as the model-implied labor supply curves at the extensive margin.

This juxtaposition can provide a goodness-of-fit test (e.g., a Kolmogorov-Smirnov test), as a way to assess the similarity of a given model-distribution and the empirical target. The reservation wedge approach permits this comparison. E researcher may even want to calibrate a given model's implied wedge distribution to match the empirical target. In many cases, as we showed, the reservation wedge distribution inherits or arises from complex distributional assumptions and parametric choices that are otherwise difficult to discipline. For example, in the Rogerson and Wallenius (2008) model, we clarified that the the age distribution and the productivity distribution jointly determine the wedge distribution. The link becomes substantially less transparent in models with heterogeneous agents and stochastic income processes.

To illustrate the payoff from this approach, in Figure 4 we conclude our paper by plotting the wedge distributions as aggregate labor supply curves for the models from Section 3, against the *empirical* curve from our custom survey for the U.S. population.

At the normalized-to-one original aggregate prevailing wedge, all curves overlap. This is because 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.[18] We additionally report descriptive statistics of the global labor supply curves in Table 2. In Table 3, we report local arc elasticitvies for various intervals around the prevailing aggregate wedge. (We normalize the prevailing aggregate wedge around 1 without loss of generality. This implies that any prevailing taxes in the model are included in the reservation wedge measure, and the relevant wage in the reservation wedge is the after-tax wage.)

Inspecting the empirical CDF, we find a local Frisch elasticity of desired extensive-margin labor supply of around 3. Interestingly, this value is close to calibrations of macroeconomic models, yet an order of magnitude than larger than quasi-experimental estimates of realized employment adjustment to short-run net-wage changes,Chetty et al. (2012). This local elasticity aligns best with the Rogersen-Wallenius model, our HACT model (albeit a two-state income model), and the high-elasticity MaCurdy model with a representative household.

However, the empirical arc elasticity is far from constant for non-infinitesimal intervals, as the empirical curve is distributed in a way not easily described by a parametric distribution. This can be seen in In Table 3, where neither the empirical arc elasticities nor the model-implied ones are stable, suggesting that no model provides an accurate description of the extensive-margin employment preferences for a fairly tight range of wedge/wage pertubations.

5.2 Micro Labor Supply Outcomes: Model vs. Data

The framework also provides a diagnostic tool to shed direct light on the allocative consequences of desired labor supply in the data: the reservation wedge is the sufficient statistic for an *individual's rank in the aggregate labor supply curve* along which aggregate employment adjustment should occur (in response to proportiate wage/wedge changes). 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.

By testing to which degree actual employment behavior lines up with the structural preferences, this exercise also helps understand the potential discrepancy between the implied large local elasticities of preferences in the data and the quasi-experimental estimates (Chetty, Guren, Manoli, and Weber, 2012).

To investigate the empirical consequences of such rationed labor supply, we sort workers by their reservation wedges, which in our model fully characterizes their desired labor supply at the

[18] 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). Accordingly, our custom survey targets workers 18 and older without an upper age limit.

extensive margin. We then relate the wedges to empirical *realized* employment outcomes past, present and future, e.g. using the panel structure in the surveys and administrative data.

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

$$e^*_{it} = \begin{cases} 0 & \text{if} \quad 1 - \tau^*_{it} > 1 - \mathcal{T}_t \\ 1 & \text{if} \quad 1 - \tau^*_{it} \leq 1 - \mathcal{T}_t \end{cases} \tag{81}$$

We then study whether realized employment allocations are aligned with these desired ones, specifically comparing .[19] Specifically, we plot the empirical employment rates $P(e_{it+s}|1 - \tau^*_{it})$ by *continuous* reservation wedges at various horizons s relative to the survey year and for our various surveys. Figure 5 presents the results using the GSOEP (a large and long household panel) and from our survey (where we included forward- and backward-looking employment questions).

Unemployed Job Seekers Figure 5 Panel (a) presents the evidence for unemployed job seekers in GSOEP using lagged earnings as the potential-wage proxy. Before the survey year, there is a clear pecking order of employment rates: 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 *after* the survey: the ranking is stable, yet the lines are noisier and less pronounced. Perhaps the event that selects the GSOEP respondent into the reservation wage question group – unemployment – is associated with a deterioration in productivity (potential wages) or preferences, leading the lagged wage concept to provide particularly concerning measurement error.

[Results under data disclosure review at time of submission.] Figure 5 Panel () plots the corresponding results for PASS, where we can use the *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.

Figure 5 Panels (c) and (d) present the results for the full cross-section of the U.S. population

[19] In our custom survey, we ask three variants: "Thinking back to the last two years, how many months were you not working (not counting vacations)?", and "Consider your future plans and expectations regarding your work situation. How many months out of the next two years do you think you will likely not be working?", and "What do you believe is the probability you will be working in a job exactly two years from now? 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 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%."

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. The data reveal a compelling downward-sliping pattern for all groups, validating the measure. However, the slope is far from clear-cut.

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.

One challenge in part motivating our analysis is that frictions dislocating labor markets are not directly observed. However, the canonical labor market matching frictions theory would interpret the presence of higher unemployment to either cause or reflect higher allocational frictions that push the labor market into less efficient rationing. In Figure 5 Panel (b) we take one empirical stab at this question by revising the German GSOEP sample, which contains sufficiently many waves to split up the sample years into high and low unemployment periods, which roughly divides 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 is somewhat flatter before 2006, consistent with the frictional interpretation, suggesting an interesting further angle to investigate.

We therefore close by reiterating that our framework and empirical implementation trace out *desired* spot-market labor supply, i.e. underlying preferences. Our framework is therefore decidedly agnostic and prior to potential real-world frictions such as search or wage rigidities, which may detach desired from actual employment allocations. Hence, our focus on (stated) preferences contrasts with, e.g., an empirical investigation of the *realized* employment effects of tax changes (e.g. Chetty, Guren, Manoli, and Weber, 2012; Martinez, Saez, and Siegenthaler, 2018; Sigurdsson, 2018), which in the presence of frictions need neither perfectly reveal preferences nor solely reflect micro choices. These estimates are therefore appropriate to calibrate the entire labor market structure of a given model, whereas our contribution helps guide the deeper structural parameters guiding labor supply preferences, a necessary model ingredient to generate behavioral responses that is perhaps prior to market structure.[20]

6 Conclusion

We have provided a tractable and robust framework that formulates and then aggregates individual-level employment decisions into an intuitive and general labor supply curve comparable across a variety of models. Individuals can be arbitrarily heterogeneous. The micro decisions are summarized by a sufficient statistic we call the reservation (labor) wedge: the tax-like gap between the extensive-margin version of the marginal rate of substitution and the actual or potential wage. The wedge is a direct measure of worker surplus in wage units. The aggregate labor supply curve is the cumulative distribution function of that micro wedge. Its argument is a hypothetical average

[20] 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).

shifter in wages, i.e. a "prevailing wedge" marking up potentially heterogeneous idiosyncratic wages. This framework can serve as a bridge between disparate labor supply blocks of popular macroeconomic models, including those where the aggregate labor supply curve would otherwise remain hard to characterize.

The framework is also empirically tractable and can in survey data be measured directly such as in our custom household survey (and proxied for in existing surveys as the reservation to actual/potential wage, albeit the limited to the unemployed). Aggregating to the distribution, we trace out the full aggregate labor supply curve at the extensive margin for the United States from our representative household sample.

This empirical short-run labor supply curve may provide a useful empirical target for labor supply blocks in macroeconomic models that feature the, empirically dominant, extensive margin. Here, our theoretical framework would provide the reservation-wedge formulation as the sufficient statistic as a bridge between data and model.

Lastly, our framework suggests an empirical handle on the allocative consequences of the *desired* labor supply statistic: the reservation wedge points out the rank of an individual in the aggregate labor supply curve, and hence the order by which efficient rationing prescribes the households to cross the extensive employment margin. A natural question is whether market settings with more severe frictions are associated with more dislocation, and whether the determination of empirical employment fluctuations occur along households' desired labor supply curves, a long-standing core question of macroeconomics (Lucas and Rapping, 1969; Krusell, Mukoyama, Rogerson, and Şahin, 2017; Mui and Schoefer, 2018).

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Tables

Table 1: Parameters of Models of Aggregate Labor Supply at the Extensive Margin

Parameter	Symbol	Value
Panel A: HACT Parameters		
CRRA consumption parameter	γ	2.0
Interest rate	r	0.03
Discount rate	ρ	0.05
Low wage level	$Z1$	0.0797
High wage level	$Z2$	0.125
Transition Rate (Low to high)	$\lambda_{1,2}$	0.1
Transition Rate (Low to high)	$\lambda_{1,2}$	0.1
Labor disutility	v	3.0
Unemployment insurance	b	0.06
Min. assets	$\underline{a}$	-0.02
Max. assets	$\bar{a}$	0.75
Panel B: Rogerson-Wallenius		
Interest rate	r	0.0
CRRA consumption parameter	γ	2.0
Minimum hours	$\bar{h}$	0.258
Maximum labor productivity	e_0	1.0
Slope of labor productivity	e_1	0.575
Labor disutility shifter	Γ	42.492
Int. margin Frisch labor supply elasticity	η	0.5
Tax rate	t	26.0%
Panel D: MaCurdy with Iso-Elasticity 0.32		
Frisch Elasticity	α_v	0.32
CRRA consumption parameter	σ	1.00
Equilibrium Wage	$\bar{w}$	1.00
Max. Labor Disutility	v_{max}	4.759
Panel C: MaCurdy with Iso-Elasticity 2.5		
Frisch Elasticity	α_v	2.50
CRRA parameter	σ	1.00
Equilibrium Wage	$\bar{w}$	1.00
Max. Labor Disutility	v_{max}	1.221
Panel E: Hansen (Indivisible Labor)		
Ext. Margin Labor supply disutility	$\bar{v}$	1.0
Wage	$\bar{w}$	1.0
Marginal utility of consumption	$\bar{\lambda}$	1.0

Table 2: Reservation Wedge Distributions: Descriptive Statistics from Theoretical Models and U.S. Data

Statistic	Rogerson Wallenius	Heterogeneous Agent	MaCurdy (0.32)	MaCurdy (2.5)	Hansen (Indiv. Labor)	**Data**: U.S. Pop (Authors' Survey)
Mean	0.96	1.02	1.16	0.87	1.00	0.832
Median	0.94	0.95	0.56	0.93	1.00	0.95
25 Pctile.	0.83	0.56	0.07	0.70	1.00	0.7
75 Pctile.	1.09	1.30	1.95	1.09	1.00	1.5
Pct. < 1	60.7%	60.7%	60.5%	60.7%	0.0%	65.1%
Pct. > 1	39.3%	39.3%	39.5%	39.3%	0.0%	34.9%
Pct. > 2	0.0%	4.8%	24.4%	0.0%	0.0%	18.3%
Variance	0.024	0.25	1.80	0.07	0.0	0.238
Skewness	0.387	0.69	1.10	-0.73	-	0.657
Kurtosis	-1.014	3.06	3.00	2.76	-	6.210

Survey: Variance, Skewness, and Kurtosis were calculated according to Rimoldini (2014), truncating wedges above 2.0.

Table 3: 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**						
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
Rog.-Wall.	1.74	2.87	1.73	2.84	1.76	2.90
Het. Agent	0.60	0.99	0.51	0.84	1.75	2.88
U.S. **Data**	6.68	0.05	2.00	0.05	4.69	0.05
Panel C: **Wedge Interval: 0.03**						
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
Rog.-Wall.	5.23	2.87	5.01	2.79	5.40	2.96
Het. Agent	2.66	1.46	1.54	0.85	2.70	1.48
U.S. **Data**	6.72	3.69	2.21	1.21	5.91	3.25
Panel B: **Wedge Interval: 0.05**						
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
Rog.-Wall.	8.72	2.87	8.30	2.74	9.18	3.02
Het. Agent	3.73	1.23	2.56	0.84	28.57	9.41
U.S. **Data**	7.65	2.52	3.63	1.20	7.07	2.33
Panel C: **Wedge Interval: 0.10**						
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
Rog.-Wall.	17.48	2.88	15.85	2.61	19.37	3.19
Het. Agent	31.13	5.13	5.08	0.84	28.71	4.73
U.S. **Data**	10.70	1.76	6.01	0.99	16.64	2.74

Table 4: 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	0.943
Median	0.83	0.83	0.926
25 Pctile.	0.64	0.75	0.826
75 Pctile.	1.2	≥ 1.0	1.01
Pct. < 1	61.0%	72.8%	70.5%
Pct. = 1	6.00%		-
Pct. > 1	33.0%		29.5%
Pct. > 2	11.3%		0.1%
Variance	2.05		0.31
Skewness	6.43		6.43
Kurtosis	70.83		7.44

Deviation from 1	+/-	+	-	+/-	+	-	+/-	+	-
	A. GSOEP			B. PASS			C. Pole Emploi		
0.01	6.18%	0.11%	0.07%				6.23%	3.03%	3.20%
0.03	7.00%	0.52%	1.09%				16.6%	7.48%	9.27%
0.05	8.50%	1.09%	1.41%				25.4%	10.4%	15.0%
0.1	14.74%	3.78%	5.96%				45.6%	16.1%	29.5%

The "+/-" column denotes the fraction of reservation wedges (reservation wage to previous wage) 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. Source: 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.

Table 5: Covariate Analysis: (Log) Reservation Wedge for U.S. Population (Authors' Survey)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Unemployed	0.047	0.030	0.047	0.111	0.113	0.034	0.096	0.076
	(0.091)	(0.101)	(0.091)	(0.091)	(0.092)	(0.088)	(0.092)	(0.092)
OOLF	1.206***	1.199***	1.215***	1.191***	1.194***	1.190***	1.178***	1.174***
	(0.077)	(0.077)	(0.075)	(0.076)	(0.076)	(0.075)	(0.074)	(0.075)
Age / 100	-0.788	-0.795	-0.658	-0.513	-0.540	-0.559	-0.371	-0.207
	(0.986)	(0.987)	(1.003)	(0.962)	(0.965)	(0.993)	(0.976)	(0.990)
$(\text{Age} / 100)^2$	0.920	0.932	0.833	0.581	0.610	0.693	0.463	0.360
	(1.103)	(1.104)	(1.123)	(1.085)	(1.088)	(1.104)	(1.094)	(1.112)
Female	-0.032	-0.030	0.019	-0.007	-0.008	-0.032	-0.009	0.071
	(0.059)	(0.058)	(0.086)	(0.055)	(0.055)	(0.059)	(0.055)	(0.085)
H.S. Diploma	0.097	0.100	0.088	0.172	0.174	0.125	0.194	0.192
	(0.181)	(0.179)	(0.182)	(0.174)	(0.174)	(0.180)	(0.178)	(0.176)
Some College	-0.002	-0.000	-0.005	0.064	0.067	0.017	0.081	0.080
	(0.173)	(0.172)	(0.173)	(0.167)	(0.167)	(0.174)	(0.171)	(0.169)
College or Higher	-0.066	-0.059	-0.068	-0.011	-0.002	-0.046	0.018	0.015
	(0.173)	(0.171)	(0.173)	(0.173)	(0.169)	(0.176)	(0.173)	(0.173)
Metro Area	-0.159	-0.157	-0.163	-0.121	-0.125	-0.159	-0.128	-0.118
	(0.123)	(0.122)	(0.123)	(0.115)	(0.116)	(0.123)	(0.115)	(0.114)
Good Health		-0.055						-0.077
		(0.089)						(0.092)
Partnered			-0.020					0.018
			(0.092)					(0.094)
Partnered x Female			-0.060					-0.098
			(0.110)					(0.108)
Any kids			0.091					0.115
			(0.076)					(0.074)
Female x any kids			-0.067					-0.069
			(0.097)					(0.096)
Assets / HH Income				0.065*				0.064*
				(0.032)				(0.031)
Debts / HH Income				-0.045				-0.034
				(0.029)				(0.026)
Net. Assets / HH Income					0.057*		0.051*	
					(0.024)		(0.024)	
$0 < C.C. Debt < $3.5k						0.051	0.031	0.019
						(0.070)	(0.064)	(0.061)
C.C. Debt > $3.5k						-0.129*	-0.123*	-0.134*
						(0.060)	(0.060)	(0.060)
Liquid Assets under $1000						-0.108	-0.040	-0.051
						(0.090)	(0.094)	(0.092)
Constant	-0.177	-0.136	-0.229	-0.315	-0.305	-0.180	-0.315	-0.347
	(0.330)	(0.353)	(0.329)	(0.308)	(0.314)	(0.331)	(0.318)	(0.324)
N	788	788	788	772	772	788	772	772
R^2	0.49	0.49	0.49	0.49	0.49	0.49	0.50	0.50

Standard errors in parentheses. Construction of reservation wedges and sample are described in main text. Source: Authors' Commissioned Questions in the NORC Amerispeak Omnibus Survey. Also includes a set of region fixed effects (9 regions).

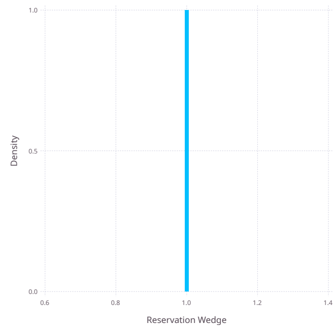
Table 6: Covariate Analysis: (Log) Reservation Wedge for German Job Seekers (GSOEP)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Age	-0.049***	-0.040***	-0.050***	-0.047***	-0.053***	-0.051***	-0.046***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Age Sq.	0.000***	0.000***	0.001***	0.000***	0.001***	0.001***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
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***
			(0.018)				(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***
					(0.017)		(0.018)
Satis. Leisure High					-0.134***		-0.108***
					(0.017)		(0.017)
Concerned Finances (somewhat)						0.079***	0.049*
						(0.021)	(0.021)
Concerned Finances (very)						0.166***	0.094***
						(0.021)	(0.022)
Constant	1.309***	1.186***	1.368***	1.348***	1.475***	1.197***	1.326***
	(0.074)	(0.076)	(0.073)	(0.074)	(0.076)	(0.076)	(0.080)
N	9817	9817	9817	9817	9817	9817	9817
r2	0.06	0.06	0.07	0.06	0.06	0.07	0.08

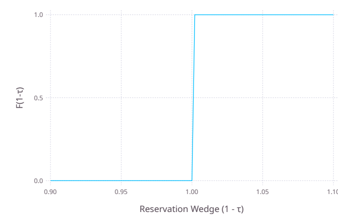
Standard errors in parentheses. Construction of reservation wedges and sample are described in main text. Source: German Socio-Economic Panel.

Figures

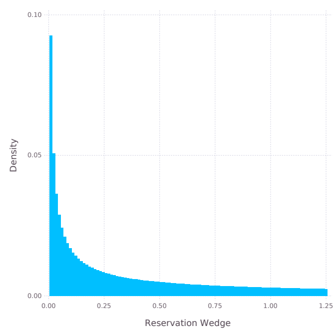
Figure 1: Model Distributions of Reservation Wedges (Left) and Aggregate Labor Supply Curves (Right)



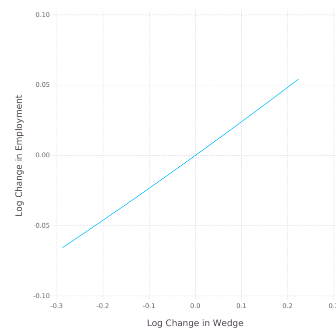
(a) Hansen (1985): Dist. of Reservation Wedges



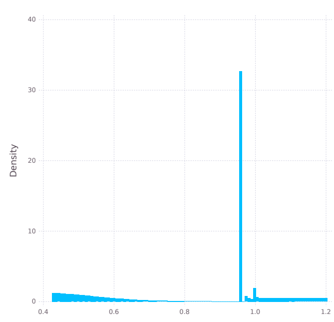
(b) Hansen (1985): Aggregate L.S.



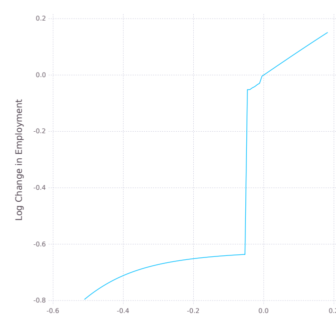
(c) MaCurdy: Dist. of Reservation Wedges



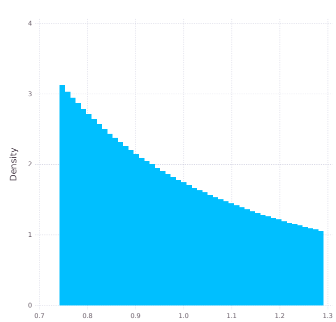
(d) MaCurdy: Aggregate L.S.



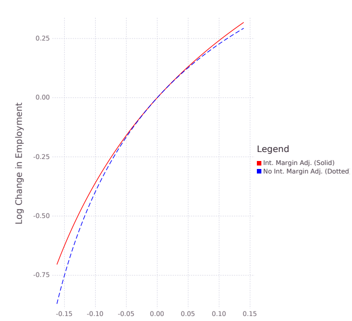
(e) HACT with Extensive Margin: Dist. of Reservation Wedges



(f) HACT with Extensive Margin: Aggregate L.S.

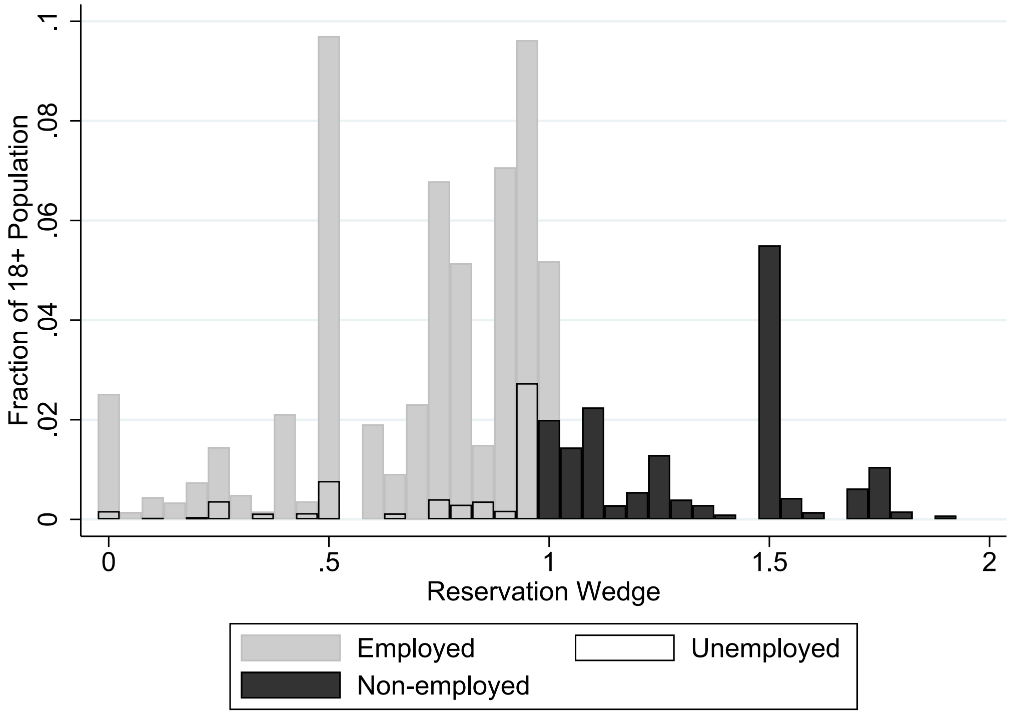


(g) Rogerson-Wallenius: Dist. of Reservation Wedges

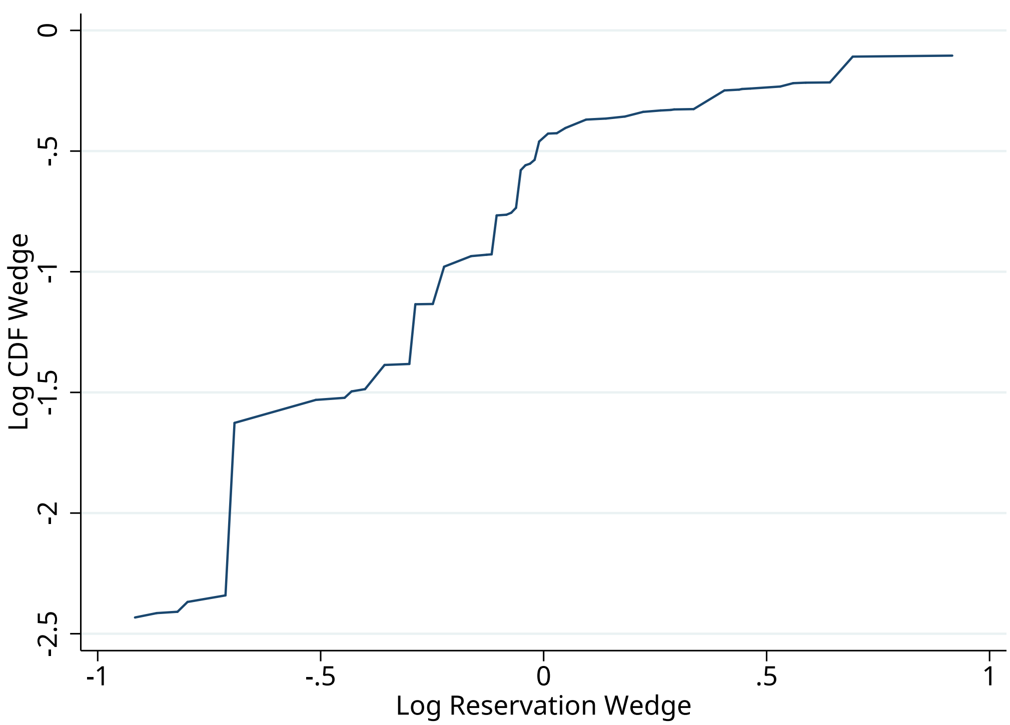


(h) Rogerson-Wallenius: Aggregate L.S.

Figure 2: Empirical Distribution of Reservation Wedge Proxy in the United States



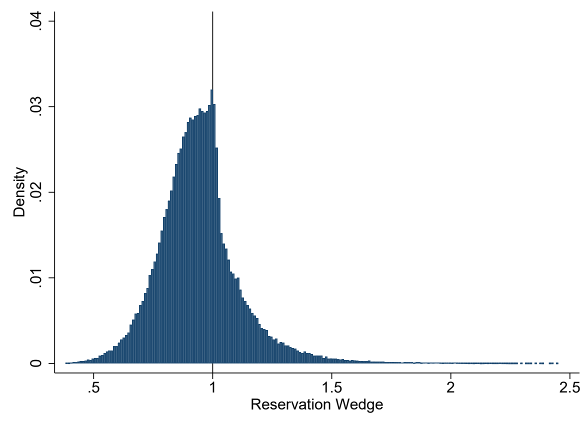
(a) Empirical Distribution of Reservation Wedge Proxy in the United States



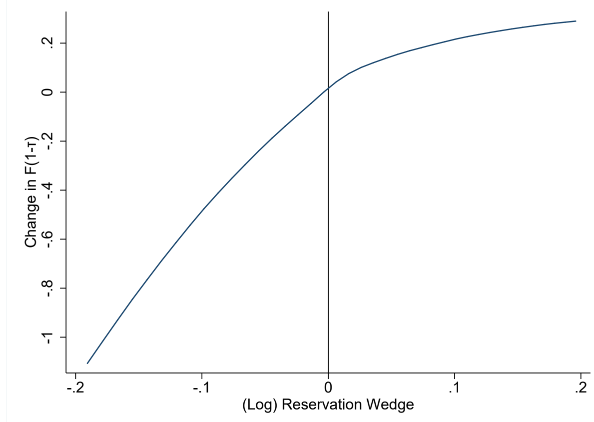
(b) Aggregate Labor Supply Curve in the United States

Source: author's custom survey (NORC AmeriSpeak/UChicago).

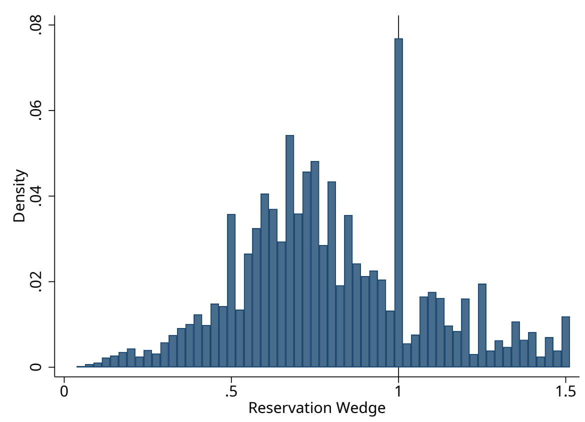
Figure 3: Distribution of Reservation Wedges from Three Reservation Wage Surveys of Unemployed Job Seekers: Pôle Emploi Administrative Survey, GSOEP Household Survey, PASS Household Survey



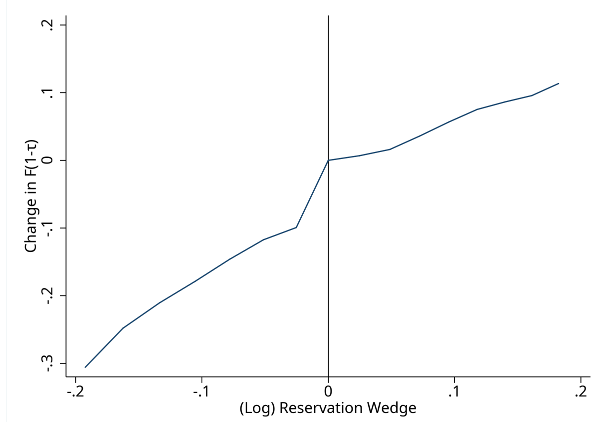
(a) Pôle Emploi: Dist. of Reservation Wedges



(d) Pôle Emploi: Agg. L.S. Curve

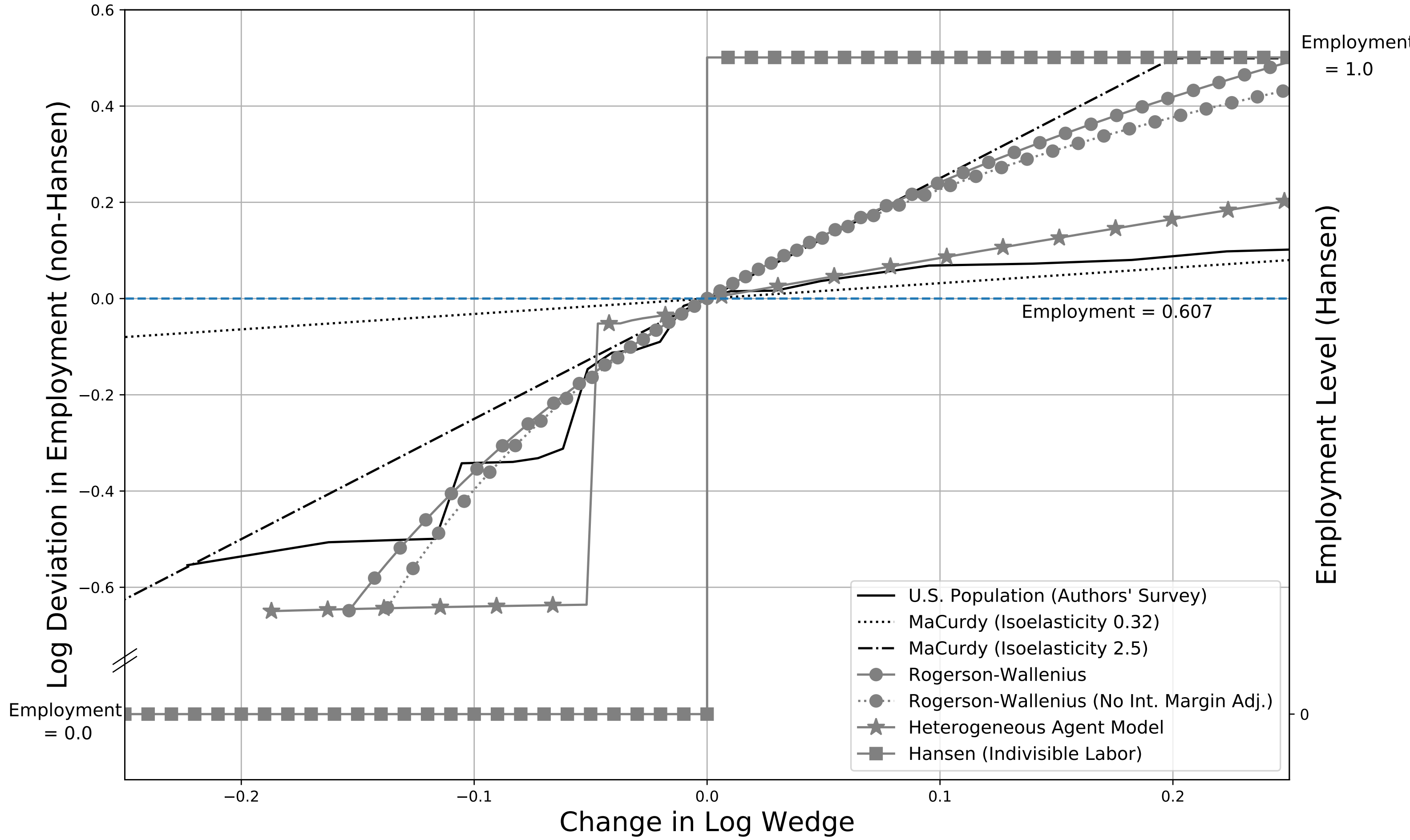


(c) GSOEP: Dist. of Reservation Wedges



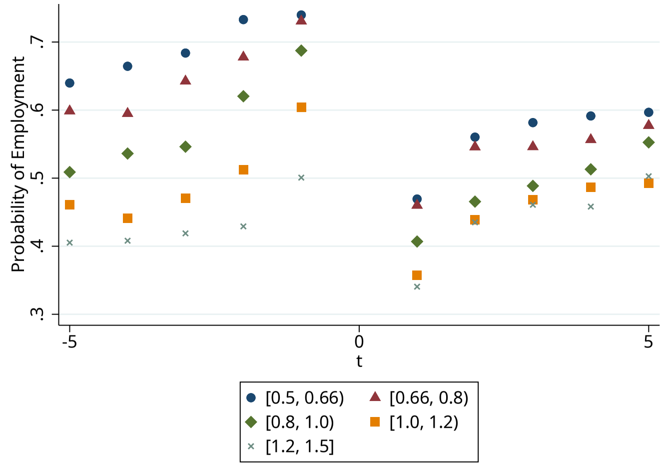
(d) GSOEP: Agg. L.S. Curve

Figure 4: Comparing the Complete Labor Supply Curves: Model-Implied vs. Data



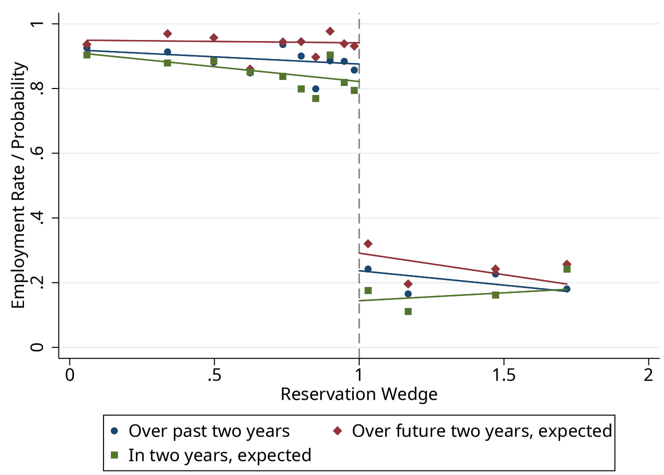
The MacCurdy lines refer to Frisch elasticities of 0.32 and 2.5, respectively. Note that the Hansen Indivisible labor is plotted on a employment level axis; all other series are plotted on log deviations from steady state employment (for models) or current employment levels (for the U.S. population, from the authors' survey).

Figure 5: Employment Dynamics, by Reservation Wedges

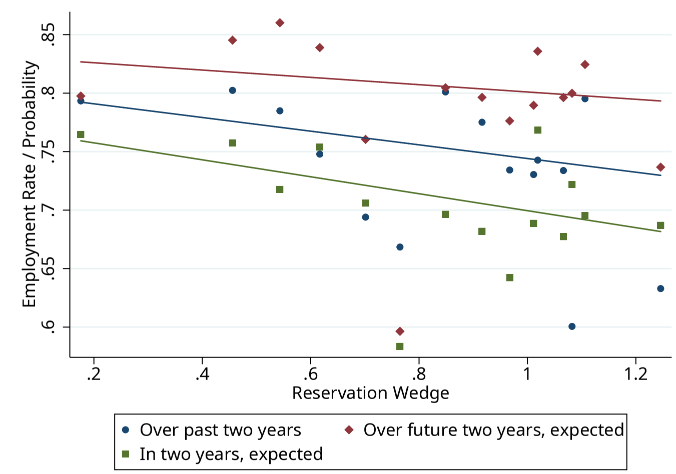


(a) Employment Dynamics, by Reservation Wedges in GSOEP

(b) Employment Dynamics by Aggregate Labor Market State, by Reservation Wedges in GSOEP



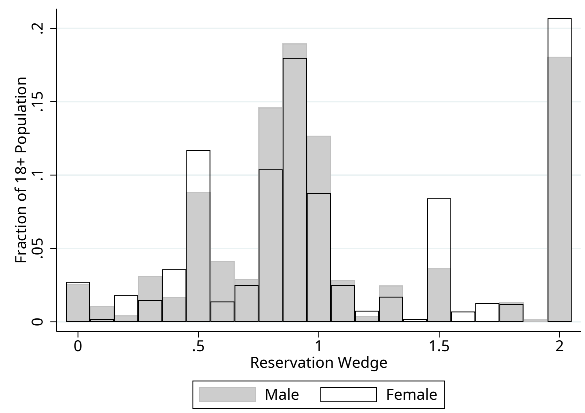
(c) Pooling Employed/Unemployed vs. OOLF Respondents



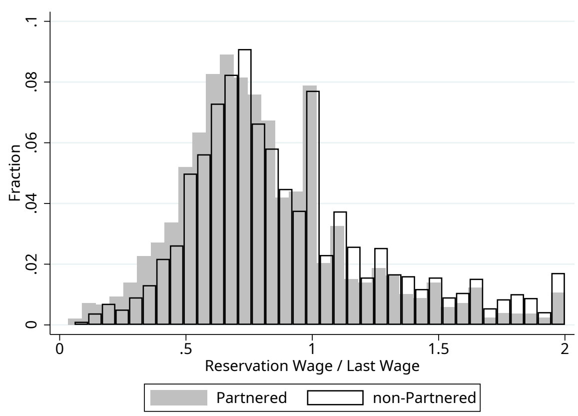
(d) Controlling for Labor Force status

Figure 6: Distribution of Reservation Wedges from the GSOEP Household Survey and Authors' Survey of American Adults

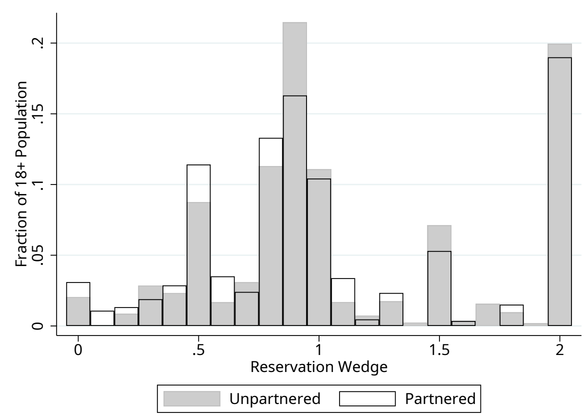
(a) GSOEP: Distribution by Gender



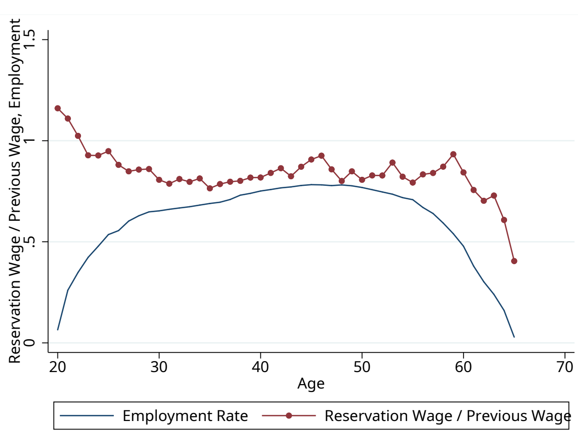
(b) U.S. Population: Distribution by Gender



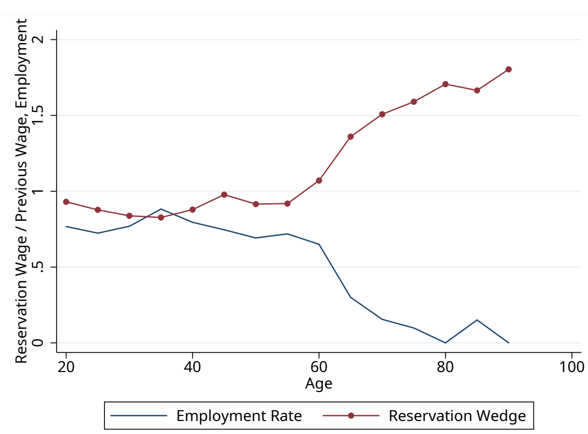
(c) GSOEP: Distribution by Partnership Status



(d) U.S. Population: Distribution by Partnership Status



(e) GSOEP: Reservation Wedges and Employment by Age



(e) U.S. Population:: Reservation Wedges and Employment by Age

Online Appendix of:

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

Preston Mui and Benjamin Schoefer

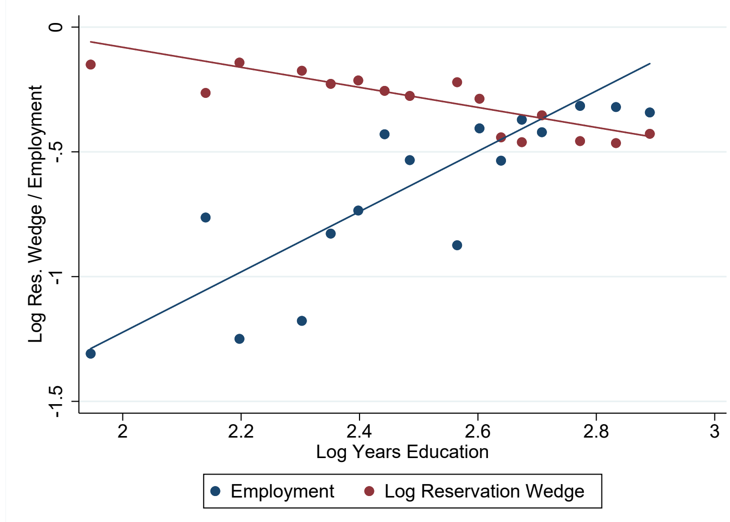
A Empirical Appendix

A.1 Detailed Data Description

B Additional Figures

Figure A1: Reservation Wedge in Achdou, Han, Lasry, Lions, and Moll (2017) with an Extensive Margin

Figure A2: Reservation Wedge Proxies and Employment Rates in German Workers: by Years of Education



Data from GSOEP. Employment rates are taken from the whole sample, since our reservation wedge proxy is constructed from the reservation wage, which is only reported by unemployed individuals.

C Computational Details

C.1 Solving Rogerson and Wallenius (2008)

The original RW distribution of 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 according to the Technical Appendix of Chetty et al. (2012).

Paramaterization of the RW model involves choosing the utility function parameters (α, the labor disutility shifter, γ, the labor supply intensive margin elasticity), effective labor supply parameters ($\bar{h}$, 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. Following Chetty et al. (2012), we choose the remaining three parameters to match three moments: the employment rate (60.7% for American adults), the maximum intensive margin hours choice (0.45), and the ratio of the lowest wage to the highest wage (0.5) over the lifecycle. This paramaterization sets $\alpha = 42.492$, $\bar{h} = 0.258$, and $e_1 = 0.575$.

For each generation, indexed by a, we calculate hours at each age, $h^*(a)$, and then calculate the wedges using $1 - \tau^*_{it}(a) = \frac{(1-t)w(a)(h^*(a)-\bar{h})u'(c(a))}{v(h^*(a))}$. 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 $1 - \tau^*_{it}(a) = 1$.

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 $\epsilon_{E_t,1-\mathcal{T}_t}$ by approximating $f(1-\mathcal{T}_t)$ as $\left(\sum_{a=0}^{1} 1[1-\mathcal{T}_t < 1-\tau^*_{it}(a) < 1-\mathcal{T}_t + 0.001\right) da$, where da is the distance between generations, and $F_t(1-\mathcal{T}_t)$ as $\sum_{a=0}^{1} 1\left[1-\tau^*_{it}(a) < 1-\mathcal{T}_t\right]$.

C.2 Solving Achdou, Han, Lasry, Lions, and Moll (2017)

Here we describe our modification to Achdou, Han, Lasry, Lions, and Moll (2017) to make labor supply decisions extensive margin only, and how we modify the algorithm described in their appendix to solve the model.

Individuals solve

$$\max_{\{c_t,l_t\}_{t\geq 0}} \mathbb{E}_0 \int_0^\infty u(c_t,l_t)dt \text{ s.t.} \tag{A1}$$

$$\dot{a} = w_t l_t + b(1-l_t) + r a_t - c_t \tag{A2}$$

$$a_t \geq a \tag{A3}$$

where w_t follows a Poisson process with transition intensities $\lambda_{w,w'}$ from state w to state w'. b is the unemployment insurance, which is paid when $l_t = 0$. Households endogenously choose their labor supply l_t, which is restricted to 0 or 1. The instantaneous utility function is given by

$$u(c,l) = \frac{c^{1-\gamma}}{1-\gamma} - vl \tag{A4}$$

where v is the disutility of labor supply at the extensive margin. Since there is no hours choice, the disutility from labor is either v (if $l = 1$), or 0 ($if\, l = 0$). The rest of the problem set-up and solution is the same as in Achdou et al. (2017). The main difference is that now individuals can no longer exactly equate the marginal utility of consumption (times the wage) to the marginal disutility of labor; in fact, almost all individuals will be off their intensive margin labor supply curve (in particular, all unemployed people will be off their intensive margin labor supply curve if the individuals have MacCurdy-like preferences).

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

$$u_c(c(a,w), l(a,w)) = V_a(a,w) \tag{A5}$$

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

$$l(a,w) = \begin{cases} 1 & \text{if } V_a(a,w)w > v \\ 0 & \text{if } V_a(a,w)w < v \end{cases} \tag{A6}$$

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

$$l(\underline{a},w) = \begin{cases} 1 & \text{if } \frac{(w+ra)^{1-\gamma}}{1-\gamma} - v > \frac{(ra)^{1-\gamma}}{1-\gamma} \\ 0 & \text{otherwise} \end{cases} \tag{A7}$$

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

The solution algorithm follows Achdou, Han, Lasry, Lions, and Moll (2017). The HJB equation associated with this maximization problem is

$$\rho V(a,w) = \max_{c,l}\{V_a(a,w)(wl + ra - c) + \sum_{w' \in W} \lambda_{w,w'}(V(a,w') - V(a,w))\}$$

The forward difference approximation of $V_a(a,w)$ follows Achdou et al. (2017). In addition to solving for consumption, given a value function guess, there is an extra step to solve for the labor supply choice:

$$l^n(a,w) = \begin{cases} 1 & \text{if } V_a^n(a,w)w > v \\ 0 & \text{if } V_a^n(a,w)w < v \end{cases} \tag{A8}$$

where l^n is the labor supply choice implied by the value function guess V^n.

The paramterization is not chosen to fit any particular empirical moments (except for the equilibrium employment rate, which is 0.607), but rather to demonstrate the potential complexity of extensive margin labor supply in such a model. The paramaterization of the model is in Table 1.

The reservation wedge for someone of asset level a and wage level w is

$$1 - \tau_{aw}^* = \frac{(w-b)c(a,w)^{-\gamma}}{v}$$

This, along with the equilibrium distribution of (a,w) delivers the distribution of reservation wedges.