

Labor Supply Elasticities: Can Micro Be Misleading for Macro?*

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Abstract

In this paper we compare "micro" and "macro" labor supply elasticities in a MaCurdy equation derived from a life-cycle model with home production. Using PSID data, we estimate the micro elasticity using standard panel techniques and the macro elasticity from the time series generated by aggregating employed individuals every year. We find an individual elasticity of about 0.1, a low value in line with mainstream microeconomic studies, and a much larger aggregate elasticity of about 1.8. There is no conflict between the two estimates. The discrepancy is due to the fact that the micro elasticity reflects the intensive margin only, i.e. the small variation in hours worked, while the macro elasticity reflects the extensive margin as well, i.e. the large variation in employment. An implication of this result is that micro evidence is not always appropriate for calibrating an aggregate model economy.

JEL Classification Codes: E13, E32, J22

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1 Introduction

The intertemporal substitution of leisure is crucial for the explanation of business cycles in modern macroeconomics. When stating how the benchmark RBC model should be calibrated, Prescott (1986) suggested to restrict the stochastic growth model on the basis of the available micro-econometric evidence:

“A fundamental thesis of this line of inquiry is that the measures obtained from aggregate series and those from individual panel data must be consistent. After all, the former are just the aggregates of the latter.” (p. 14).

Microeconomic studies based on both cross-sections and panel data typically report a small real-wage elasticity [e.g. Pencavel (1986), Killingsworth and Heckman (1986), MaCurdy (1981), Altonji (1986)], ranging from about 0 to about 0.2 for men and from about 0 to about 1 for married women [Blundell and MaCurdy (1999)]. To reproduce all business cycles facts, however, the benchmark RBC model requires a much larger elasticity. This difficulty is noticed by several authors such as Heckman (1993), Browning, Hansen and Heckman (1999) and by Prescott himself (2006).

The macroeconomic evidence is far less numerous, and is generally mixed. In their seminal paper, Lucas and Rapping (1969) find that, for the US economy (1930-1965), total hours are strongly real-wage elastic in the short-run (1.4). Among the others, Hall (1980) finds an intertemporal elasticity of substitution of about 0.5, while Mankiw, Rothemberg and Summers (1985) reject the intertemporal substitution hypothesis altogether.

The necessity of reconciling the relatively large aggregate elasticity assumed in calibration studies with the small elasticity estimated in microeconomic studies brought about a number of different orientations. In some cases [e.g. Summers (1986), Mankiw (1989)] the whole relevance of the RBC approach was denied. A more constructive orientation explored several variants of the benchmark RBC

model [i.e. Prescott (1986)] in order to better accommodate the data. A precursor is the seminal work of Kydland and Prescott (1982) based on non-separability of leisure at different points in time. This was followed by the lottery [Rogerson (1988)] and the indivisible labor model [Hansen (1985)] where people can only work a fixed number of hours. Among the other relevant extensions, the introduction of preference shocks [Bencivenga (1992)], government consumption [Christiano and Eichenbaum (1992)], home production [Benhabib, Rogerson and Wright (1991)], and taxation in general equilibrium [Baxter and King (1993); McGrattan (1994)] are all noteworthy efforts to add realism and policy focus to the benchmark RBC model.

On the empirical side, several studies try to reduce the elasticity gap by showing that standard micro regressions are misspecified. Examples are the omission of wealth [Ziliak and Kniesner (1999)], the omission of hours of home production [Rupert, Rogerson, and Wright (2000)], the presence of liquidity constraints [Domeji and Floden (2006)], and time devoted to human capital accumulation [Imai and Keane (2004)]. Finally, Chang and Kim (2006) and Gourio and Noulal (2006) show the importance of heterogeneous reservation wages. Needless to say, this list is incomplete.

In this paper, we take a different approach and ask the following question: is a small individual Frisch elasticity of labor supply consistent with a large aggregate one? We answer this question by estimating two distinct MaCurdy equations. The first, the micro equation, relates individual hours to the individual wage rate and is estimated using panel data from the PSID. This identifies the micro elasticity. The second, the macro equation, relates aggregate hours to the aggregate wage rate and is estimated in a time series obtained by aggregating the single waves of the panel each year. This identifies the macro elasticity. This approach clarifies that micro and macro estimates of the elasticity of labor supply do not refer to the same variable. Micro estimates deal with individual hours of work per unit of time (intensive margin), while macro estimates deal with total hours of work, i.e. the product of hours per worker and the employment rate (extensive mar-

gin). This fundamental difference is stressed, among others, by Heckman (1993). This procedure allows us to compare in a fully consistent way micro and macro elasticities. By consistent we mean using the same units in the same dataset and employing the same specification and estimation method, including the choice of instruments.

The answer to the question we ask is yes: we find a micro Frisch elasticity of about 0.1, a small value in line with benchmark microeconomic estimates, and a macro Frisch elasticity of about 1.8, a much larger value not far from what is assumed in quantitative macroeconomic models. There is no conflict between the two estimates, because they are obtained in an entirely consistent way. We decompose the aggregate elasticity into the contribution of adjustment of hours per worker and employment, finding that the latter accounts for the difference between our micro and macro estimates.

The fact that empirically the extensive margin dominates the intensive one is well known [e.g. Hansen (1985), Cho and Cooley (1994), Kydland (1995)]. Correspondingly, in contrast to Mankiw, Rothemberg and Summers (1985) who estimate the intensive margin only, Alogoskoufis (1987) shows that when applied to aggregate employment the intertemporal substitution hypothesis is not rejected by the US data. Yet, our contribution is new: to the best of our knowledge, this is the first time that micro and a macro elasticities are *estimated* from the same data. A few studies have addressed the same quantitative question starting from a *calibrated* micro elasticity. Chang and Kim (2006) combine the indivisible labor assumption and the heterogeneity of reservation wages in an incomplete markets model. Assuming an individual elasticity of 0.4 they find an aggregate elasticity of about 1. Similarly, Rogerson and Wallenius (2009) assume an individual elasticity ranging from 0.05 to 1.25 and find that the corresponding macro elasticity ranges between 2.25 and 3. This result is generated by a non-linear mapping between hours of work and labor services that is reminiscent of indivisible labor: an individual must work at least a certain amount of hours to produce something. This same non-convexity is employed by Prescott, Rogerson, and Wallenius (2009) to

endogenize the length of the workweek.

We connect the evidence we produce to a life-cycle model where the extensive margin matters because people are engaged in either market or home production. Therefore, we suggest that the aggregate elasticity is larger because people optimally move into and out of employment in response to productivity shocks and taking into account their preferences for home vs. market consumption goods.

The paper is organized as follows. In Section 2 we briefly discuss the relation between intensive and extensive margin on the one hand and micro and macro elasticities on the other. Section 3 illustrates the model. Section 4 presents our empirical results, and Section 5 concludes. A data appendix is available in Section 6.

2 Intensive vs. Extensive Margin

The indivisible labor case [Rogerson (1988); Hansen (1985)], where individuals either work a fixed amount of hours or do not work at all, accommodates in an extreme way the evidence that labor adjustment on the extensive margin dwarfs adjustment on the intensive margin. Like in Hansen (1985), if we denote by n_t the employment stock and by \bar{h}_t the average supply of hours, then aggregate labor is $H_t \equiv n_t \bar{h}_t$. By taking logs, the variance of labor input can be decomposed as follows:

$$\text{var}(\ln H_t) = \text{var}(\ln n_t) + \text{var}(\ln \bar{h}_t) + 2\text{cov}(\ln n_t, \ln \bar{h}_t). \quad (1)$$

The share of the total variation that is due to n_t provides a measure of the importance of the extensive margin. For quarterly US data ranging from 1955 to 1984, Hansen (1985) finds that employment changes account for 55% of the total hours deviations from the HP trend, while the hours per worker deviations account for only 20%. This pattern is observed in several countries: in HP-filtered, quarterly, manufacturing data (1960-1989), Fiorito and Kollintzas (1994) found that the volatility of employment deviations from the smooth trend always exceeds

the corresponding volatility in hours per worker: by a factor of about eight in the US, about four in Canada and West Germany and between two and three in the UK and in Japan, respectively.

The wedge between individual and aggregate elasticities, as conventionally estimated, reflects such a primacy of the extensive margin. This is easy to see in a regression framework. Henceforth, we use lower case for individual variables and upper case for the corresponding aggregate quantity. Denote by ε and \mathcal{E} the micro and macro Frisch elasticities of labor supply, respectively, by w_t and W_t the individual and aggregate wage rates at time t , respectively, and by h_t the individual hours worked. Consider the following MaCurdy (1981) regressions, which provide the benchmark for estimating a Frisch elasticity:

$$\text{individual} \quad : \quad \Delta \ln h_t = \kappa + \varepsilon \Delta \ln w_t + v_t, \quad (2)$$

$$\text{aggregate} \quad : \quad \Delta \ln H_t = K + \mathcal{E} \Delta \ln W_t + V_t. \quad (3)$$

The population elasticities are:

$$\varepsilon = \frac{\text{cov}(\Delta \ln h_t, \Delta \ln w_t)}{\text{var}(\Delta \ln w_t)}, \quad (4)$$

$$\begin{aligned} \mathcal{E} &= \frac{\text{cov}(\Delta \ln H_t, \Delta \ln W_t)}{\text{var}(\Delta \ln W_t)} \\ &= \frac{\text{cov}(\Delta \ln \bar{h}_t, \Delta \ln W_t)}{\text{var}(\Delta \ln W_t)} + \frac{\text{cov}(\Delta \ln n_t, \Delta \ln W_t)}{\text{var}(\Delta \ln W_t)}. \end{aligned} \quad (5)$$

That is, the micro elasticity (4) consists of a single term that captures adjustment on the intensive margin by continuously employed individuals. Correction for selection into employment would only eliminate the bias stemming from missing changes in hours by individuals who are not employed, but not the bias stem-

ming from omission of the extensive margin. The macro elasticity (5) instead, is the sum of two terms representing the aggregate intensive margin and the extensive margin, respectively. The second term is the covariance between the growth rates of employment and of the aggregate wage rate which is positive if we move along a labor supply curve. This decomposition, which extends to identification via instrumental variables, illustrates that individual and aggregate elasticities are conceptually different objects. [Prescott (2006)]. In fact the macro elasticity is defined as the response of total hours, which can be expressed as the product of two components reflecting different decisions and having, empirically, quite different relevance. We illustrate this point by means of a simple model.

3 The Model

Consider an economy populated by N individuals, indexed by $i = 1, \dots, N$. There are two different and possibly overlapping consumption goods, which include services and which can be produced on the market (c) and at home (c^H). There is no intermediate consumption. An individual's marginal product on the market at time t is denoted θ_{it} . The same individual has productivity θ_{it}^H at home. We assume that labor is the only input in the production of the home good so θ_{it}^H is also the marginal product. Both θ_{it} and θ_{it}^H are econometrically exogenous univariate processes, driven by innovations that are independent over time and, possibly, cross-correlated.

Individuals are endowed with one unit of time in each period, and h_{it} and h_{it}^H are the fractions of such endowment spent working in the two sectors. Preferences are given by:

$$U(c_{it}, c_{it}^H, \ell_{it}) = \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left[\frac{(c_{it} + \phi c_{it}^H)^{1-\gamma}}{1-\gamma} - \alpha \frac{(1-\ell_{it})^{1+\frac{1}{\varepsilon}}}{1+\frac{1}{\varepsilon}} \right], \quad (6)$$

where ϕ is the marginal rate of substitution between the domestic good and the market good, and $\alpha > 0$ reflects the relative preference for leisure, ℓ . As we

illustrate below, the assumption that domestic and market goods are perfect substitutes in consumption rules out that an individual produces both on the market and at home. This is a convenient simplification for explaining extensive margin changes (see below) without invalidating the empirical analysis: if anything, it leads to a conservative estimate of elasticities relative to the general case estimated by Rupert, Rogerson, and Wright (2000).

Labor services are sold on the market at a wage rate w_{it} . Individuals are assumed to be forward looking and the credit market is perfect. Due to data limitations, we assume that the tax rate on labor is constant, so that it is immaterial whether the wage rate is pre- or after-tax.

The individual problem is to choose sequences of consumption, $\{c_{it}\}_{t=0}^{\infty}$, labor supply to market, $\{h_{it}\}_{t=0}^{\infty}$, and home production, $\{h_{it}^H\}_{t=0}^{\infty}$, as well as asset holdings, $\{a_{it+1}\}_{t=0}^{\infty}$, that maximize utility, given the budget and time constraints. That is, given a_0 :

$$\begin{aligned}
& \max_{\{c_{it}, c_{it}^H, h_{it}, h_{it}^H, a_{it+1}\}} & : & \quad U(c_{it}, c_{it}^H, \ell_{it}) \\
& \text{subject to} & : & \\
& c_{it} + a_{it+1} & \leq & \quad w_{it}h_{it} + (1+r)a_{it} + b_{it}, \\
& c_{it}^H & \leq & \quad \theta_{it}^H h_{it}^H \\
& (h_{it}, h_{it}^H) & \geq & \quad (0, 0)
\end{aligned}$$

where r is the real return on assets (assumed to be constant in time and across individuals), and b_{it} summarizes other exogenous sources of income. The transversality condition $\lim_{T \rightarrow \infty} \beta^T \frac{\partial u(c_{iT}, l_{iT})}{\partial c_{iT}} a_{iT+1} = 0$ is also required to hold in equilibrium.

At the competitive equilibrium, quantities and prices maximize utility given the budget constraint and the home production technology ($c_{it}^H \leq \theta_{it}^H h_{it}^H$), the market sector maximizes profits and markets clear. Therefore, equilibrium implies that $w_{it} = \theta_{it}$ is the market wage of individual i at time t .

Denoting by λ_{it} the marginal utility of wealth, by μ_{it} the shadow price of the

domestic good, and by ν_{it} and ν_{it}^H the multipliers of the non-negativity constraints on hours spent producing on the market and at home, respectively, the following intratemporal and intertemporal conditions hold at the equilibrium:

$$c_{it} : (c_{it} + \phi c_{it}^H)^{-\gamma} = \lambda_{it}, \quad (7)$$

$$c_{it}^H : \phi(c_{it} + \phi c_{it}^H)^{-\gamma} = \mu_{it}, \quad (8)$$

$$h_{it} : \alpha (h_{it} + h_{it}^H)^{\frac{1}{\varepsilon}} = \lambda_{it} w_{it} + \nu_{it}, \quad (9)$$

$$h_{it}^H : \alpha (h_{it} + h_{it}^H)^{\frac{1}{\varepsilon}} = \mu_{it} \theta_{it}^H + \nu_{it}^H, \quad (10)$$

$$a_{it+1} : \lambda_{it} = \beta (1 + r) E_t [\lambda_{it+1}]. \quad (11)$$

Because of the assumption that market and home goods are perfect substitutes in consumption, at the competitive equilibrium individuals fully specialize in each period, i.e. they either supply a positive number of hours to the market (so that $\nu_{it} = 0$) or spend a positive number of hours at home (so that $\nu_{it}^H = 0$) but never both. This choice depends on whether the marginal rate of substitution (ϕ) is below or above the marginal rate of transformation ($\theta_{it}/\theta_{it}^H$). That is, in equilibrium:

$$h_{it} = \begin{cases} (\lambda_{it} w_{it} / \alpha)^\varepsilon & \text{if } \theta_{it} \geq \phi \theta_{it}^H \\ 0 & \text{otherwise,} \end{cases} \quad (12)$$

$$h_{it}^H = \begin{cases} (\mu_{it} \theta_{it}^H / \alpha)^\varepsilon & \text{if } \theta_{it} < \phi \theta_{it}^H \\ 0 & \text{otherwise,} \end{cases} \quad (13)$$

which implies that $\phi \theta_{it}^H$ is the reservation wage. For individuals who work on the market, we can rewrite equations (9) and (11) in logs:

$$\ln h_{it} = -\varepsilon \ln \alpha + \varepsilon \ln \lambda_{it} + \varepsilon \ln w_{it}, \quad (14)$$

$$\ln \lambda_{it} = \ln \beta (1 + r) + \ln E_t [\lambda_{it+1}]. \quad (15)$$

Therefore, ε is the Frisch elasticity of labor supply. The unobservability of λ_{it} poses problems. We follow Blundell and MaCurdy (1999) and proceed as follows. Define a one-step-ahead forecasting error in log marginal utility of wealth as:

$$\xi_{it} = \ln \lambda_{it} - E_{t-1} [\ln \lambda_{it}]. \quad (16)$$

Equations (15) and (16) allow to characterize the implicit stochastic process for λ_{it} .¹

$$\ln \lambda_{it} = -\ln \beta (1 + r) + \ln \lambda_{it-1} + \zeta_{it}, \quad (17)$$

where $\zeta_{it} \equiv \xi_{it} - \ln E_{t-1} [\exp(\xi_{it})]$. Next, denoting by $\Delta X_t \equiv X_t - X_{t-1}$ the first difference of any variable X_t , we can rewrite (14) accordingly:

$$\Delta \ln h_{it} = \varepsilon \Delta \ln \lambda_{it} + \varepsilon \Delta \ln w_{it}. \quad (18)$$

Substituting (17) into this equation, defining $v_{it} \equiv \varepsilon \zeta_{it}$ and introducing a constant κ , we obtain:

$$\Delta \ln h_{it} = \kappa + \varepsilon \Delta \ln w_{it} + v_{it}, \quad (19)$$

i.e. a standard MaCurdy regression. Here ε is the intertemporal (Frisch, or λ -constant) elasticity of labor supply. We interpret v_{it} as containing an individual fixed-effect, and label (19) the “micro” regression.

Denoting by H_t aggregate hours, by ω_t the appropriate aggregate wage rate,

¹See Blundell and MaCurdy (1999), p. 1597, footnote 13 for details.

by η the elasticity of the first with respect to the second, and by K a constant, the corresponding MaCurdy macro regression is:

$$\Delta \ln H_t = K + \eta \Delta \ln \omega_t + V_t. \quad (20)$$

Aggregation of preferences with heterogeneous wages is an admittedly tricky issue, and we do not derive equation (20) from exact linear aggregation of individual labor supply. However, this MaCurdy macro equation implies, as we show below, a well-defined aggregate elasticity of labor supply, which is the object of interest here. Notice that under exact linear aggregation we would have $\eta = \varepsilon$. That is, the aggregate elasticity *with respect to* ω_t would be the micro elasticity. The question is what is ω_t . Notice that variations in total hours correspond in a dynamic framework to four possible choices and individual states with respect to the previous period: those who always work, those who enter employment, those who leave employment, and those who never work. Aggregate hours can in fact be written as:

$$H_t = \underbrace{\sum_{i=1}^{n_t^A} h_{it}}_{\text{work at } t \text{ and } t-1} + \underbrace{\sum_{j=n_t^A+1}^{n_t} h_{jt}}_{\text{work at } t, \text{ not at } t-1} + \underbrace{\sum_{k=n_t+1}^{n_t+n_t^O} h_{kt}}_{\text{work at } t-1, \text{ not at } t} + \underbrace{\sum_{m=n_t+n_t^O+1}^N h_{mt}}_{\text{do not work at } t \text{ or } t-1}, \quad (21)$$

where n_t is employment at time t , n_t^A is the number of employed individuals at time t and $t-1$, and n_t^O is the number of employed individuals at $t-1$ who are not employed at time t . Notice that the last two terms are sums of zeros. Accordingly, the relevant implied aggregate wage rate at time t is:

$$\omega_t = \frac{1}{N} \left(\sum_{i=1}^{n_t^A} w_{it} + \sum_{j=n_t^A+1}^{n_t} w_{jt} + \sum_{k=n_t+1}^{n_t+n_t^O} \phi \theta_{kt}^H + \sum_{m=n_t+n_t^O+1}^N \phi \theta_{mt}^H \right). \quad (22)$$

Notice that we are attributing non-workers their reservation wage, because

home production is the only alternative to market production. Equation (22) can also be written as:

$$\omega_t = e_t W_t + (1 - e_t) \phi \Theta_t^H, \quad (23)$$

where $e_t \equiv n_t/N$ is the employment rate, $W_t \equiv n_t^{-1} \sum_{i=1}^{n_t} w_{it}$ is the average wage rate of workers, and $\Theta_t^H \equiv (N - n_t)^{-1} \sum_{i=n_t}^N \theta_{it}^H$ is the average home productivity of non-workers. Since ω_t is unobservable, it cannot be used in a regression. What we observe is W_t , and we can define a parameter δ that "balances" unobservables and observables in each period:

$$\delta_t \equiv \frac{\ln(e_t W_t + (1 - e_t) \phi \Theta_t^H)}{\ln W_t},$$

or $W_t^{\delta_t} \equiv \omega_t$. Replacing this identity into (20), we obtain:

$$\Delta \ln H_t = (\delta_t \eta) \Delta \ln W_t + V_t. \quad (24)$$

In this equation, $\delta_t \eta$ is a well-defined aggregate Frisch elasticity, i.e. what we denoted \mathcal{E} in equation (3). Notice that δ_t is an increasing function of the preference parameter ϕ , and that $\delta_t > 1$ if and only if $\phi \Theta_t^H > W_t$. In other words, the aggregate elasticity is amplified with respect to η if the interaction between the strength of preferences for the home good and the average productivity of home workers is large enough compared to the average productivity of market workers. This condition implies positive (and increasing in ϕ and Θ_t^H) covariance between percentage changes in the wage rate and percentage changes in employment—the second term in equation (5)—because positive (negative) aggregate wage shocks will induce marginal individuals (whose number is also increasing in ϕ and Θ_t^H) to enter (leave) the labor force.

To summarize, we will estimate the following equations:

$$\text{individual} : \Delta \ln h_{it} = \kappa + \varepsilon \Delta \ln w_{it} + v_{it}, \quad (25)$$

$$\text{aggregate} : \Delta \ln H_t = K + \mathcal{E} \Delta \ln W_t + V_t, \quad (26)$$

where for estimation purposes we assume \mathcal{E} and δ_t are constants.²

4 Estimation and results

We use data from the core sample of the PSID. The disadvantage of this dataset is that important variables such as wealth and tax rates are not available for all waves. However, it has an important advantage for our purposes: it now covers 39 years, thus allowing the construction of a relatively long time series. However, the series we use to estimate the aggregate elasticity is shorter than it might otherwise be. The reason is that PSID data were collected annually from 1968 to 1997, and every other year afterwards. In order to avoid arbitrary interpolation of the microdata, we use only the annual portion of the panel.

We aggregate each wave to create a macro series and estimate the aggregate elasticity from the microdata used to estimate the individual one.³ In this way we can compare the two consistently. We are aware, and we document in the data appendix, that our sample is not representative of the US population. Therefore, we do not claim to provide the right estimate of the aggregate elasticity of labor supply in the US. This is not the goal of the paper, which is comparing micro and macro elasticities on the basis of a consistent aggregation procedure. However,

²This simplifying assumption is not too strong because in our data the employment rate ranges between 82% and 93% with a coefficient of variation which is rather small, about 3%. The employment rate is so high because our units of observations are PSID household heads (see data appendix).

³The estimate of the aggregate elasticity reported in a previous version of this paper **was** substantially smaller due to an error in the aggregation code that led us to double counting in most years.

when we contrast the unconditional properties of our series with aggregate US data we find that they are not too dissimilar.

As in MaCurdy (1981), we exclude from the sample permanently disabled or retired individuals. We also use two dummy variables to account for important modifications underwent by the PSID in 1993 and 1996 and a dummy variable for the anomalous behavior of average wage in 1992 (see data appendix).

It is well known that wage reported in the PSID may be affected by substantial measurement errors (Pischke 1995). Such errors are likely to be washed-out by aggregation but remain a concern in the individual regression. As a check, we will later exclude self-employed individuals—wages in this category are more likely to be affected by relevant measurement errors.

In estimating equation (25) we use, as in MaCurdy (1981), the fixed effects estimator to mitigate the problems arising from the limitations of the data. While this prevents us from estimating the long-run labor supply response to productivity, it should also avoid mixing substitution and income effect, since the latter is likely to prevail in the long run.

In a rational expectations framework, we use lags as instruments to account for the endogeneity of the real wage. The perfect correspondence between our micro and macro estimates is ensured, among the other things, by the fact that we use exactly the same instruments in both cases. Therefore, the autoregressive terms enter the micro and the macro equations with exactly the same lags, although aggregation may change the dynamics pertaining to each individual component [Granger and Newbold (1986)]. This possibility is another reason for regressing first-differenced data which tend to reduce (or eliminate) differences in persistence, otherwise to be dealt with a longer series of instruments in the macro estimate.

Our main result is summarized in Table 1. The left portion of the table reports instrumental variables fixed-effects estimates of the individual elasticity, and the right portion of the table reports instrumental variables estimates of the aggregate, time-series, elasticity. The LHS variables are the variation in log individual and

aggregate hours, respectively. The RHS variables are the variation in log individual and aggregate wage rates deflated by the urban consumer price index. In both cases, the chosen instruments are the 2nd and 3rd lags of the individual and aggregate wage rates, respectively⁴.

Table 1. Individual and aggregate Frisch elasticities.

	Individual $\Delta \ln (h_{it})$			Aggregate $\Delta \ln (H_t)$		
	1	2	3	4	5	6
$\Delta \ln (\text{wage})$	0.12** (0.037)	0.25** (0.054)	0.08* (0.035)	1.79** (0.64)	1.85* (0.76)	1.75* (0.79)
Constant	-0.007** (0.001)	-0.01** (0.002)	-0.009** (0.002)	0.004 (0.007)	0.001 (0.007)	0.004 (0.008)
<i>J</i> -stat	0.13	0.01	0.37	0.057	0.514	0.046
p-value	0.72	0.91	0.55	0.81	0.47	0.83
Self-employed	yes	no	yes	yes	no	yes
Period	1967-1996	1967-1996	1967-1991	1967-1996	1967-1996	1967-1991
Year dummies	yes	yes	no	yes	yes	no
Observations	74,708	63,749	62,151	27	27	22
Individuals	6,477	6,070	6,037	-	-	-

* Significant at 5%; ** Significant at 1%

In the table we report the results from three different specifications of both the micro and macro regressions. The first, baseline, specification (columns 1 and 4) yield an individual elasticity of 0.12 and a much larger aggregate elasticity of 1.79.

⁴Instruments are in log levels rather than in log differences for the efficiency reasons outlined by Arellano (1989). Results are, however, robust to the lag choice.

Next (columns 2 and 5), we exclude individuals who classify themselves as self-employed. For these individuals the wage rate is a mix of labor and capital income and measurement errors are more likely. Both the individual and the aggregate elasticity increase slightly: to 0.25 the former and to 1.85 the latter.

Finally (columns 3 and 6) we exclude post-1991 data to control that our result is not driven by the inclusion of the 1992, 1993, and 1996 dummies. This is, in fact not the case: in this "shorter" sample the micro elasticity is 0.08 and the macro one 1.75.

We re-estimated the micro elasticity after correcting the micro equation for selection into employment using a standard "Heckit" estimator. The baseline estimate increases slightly to 0.14, which shows that in practice selection-correction does not correct the omission of the extensive margin.

When we estimate the contribution of the intensive and the extensive margin to the aggregate elasticity, i.e. evaluate separately the two terms in the RHS of equation (5), we find that the elasticity of hours per worker is not statistically different from zero, while employment is highly real-wage elastic (about 2). This is consistent with the extensive margin inducing a large discrepancy between micro and macro elasticities.

5 Conclusions

Using PSID data for about 30 years (1967-96), we compare the individual and the aggregate Frisch elasticities of labor supply, using the same data in a MaCurdy-type equation. We acknowledge the many limitations of our data and we do not interpret our results as necessarily relevant for the US and even less for other countries for which sufficiently long data are not available.

We find that the panel estimate of the individual labor supply elasticity differs by an order of magnitude from the time-series estimate obtained by aggregating each year the hours worked in the sample. For the micro elasticity we find a low value (about 0.1) in line with mainstream empirical results. For the macro

elasticity, we find a relatively large value (about 1.8).

This difference between micro and macro elasticities is not new in the literature and is often invoked as a reason for rejecting the RBC model. Our result, however, shows that there is no contradiction between the two, because they pertain to two different variables and concepts: the intensive margin in one case and its product with the much more volatile extensive margin, in the other. The underlying utility maximization model aims at explaining the dominance of the extensive margin on the basis of the intertemporal and intratemporal choice between leisure and labor to be allocated to market- or home-production.

The main contribution of this paper is showing that aggregation alone leads in a MaCurdy equation to a much larger elasticity than it is commonly found in micro estimates. This happens because micro estimates cannot reflect participation decisions, even when using some selectivity correction mechanism.

Though our result could apparently vindicate previous macroeconomic estimates showing a larger elasticity with respect to the micro mainstream, we think that this vindication would be rather superficial if not based on proper aggregation of the individual units. We regard our work as a simple empirical exercise, but we are not aware of other studies testing the relevance of the extensive margin via the aggregation of exactly the same individual units. Finally, our result suggests a potentially intriguing methodological point: parameter estimates from micro data are not always appropriate for calibrating an aggregate model economy. Certainly, not in this case.

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6 Data Appendix

In this appendix we provide additional details on our dataset and we compare the time series derived from aggregating individuals in the PSID with official aggregate US data (sources: BLS and OECD labor statistics). Although such comparison is not necessary to make our empirical point, it turns out that despite the non-representativeness of our sample the properties of the aggregate PSID series are consistent with the properties of aggregate US data.

Our data come from the core sample of the PSID, family file, 1968-2007. Therefore,

our units of observations are household heads. We label years to reflect the time data refers to, not the time they were collected. For example we refer to the first PSID wave, released in 1968, as year 1967, and to the 1997 wave as year 1996. Figure 1 reports series of average age and percentage male, weighted using PSID sample weights. It is clear that our sample is not representative of the US population. In particular, men are over-represented, which is what one expects given that we use household heads—conventionally these are males when a family includes a married couple.

Figures 2 and 3 compare log hours worked variations and log employment variations in the PSID and in the US, i.e. the intensive and the extensive margins. The series in Figure 2 tend to move together quite closely although the PSID is more volatile. The series in Figure 3 show large discrepancies in three years: 1968, 1993, and 1996. Such discrepancies reflect the variations in the composition of the PSID. In particular, in 1993 we observe a large increase due to the inclusion of "recontacts", i.e. persons who had been lost because of attrition during the previous ten years and who were re-contacted and re-added to the sample. This implies a significant exogenous increase in employment which we don't want to confuse with movements along the extensive margin. The same problem affects year 1996, when sample size underwent a major reduction as part of a process to reduce the cost of the survey. We control for such exogenous variations in employment with two dummies for years 1993 and 1996. Year 1968 is not a problem because the first effective observation in our estimates, given the use of first differences and lags as instruments for wages, is 1971. We have shown in Table 1 that our result is robust to shortening the series to avoid using these two dummies.

Finally, Figure 4 compares log real aggregate wage variations in the PSID and in the US. The two series are not fully comparable because the US series refers to private nonfarm workers involved in production and non-supervisory tasks. All nominal values are converted into real terms using the CPI urban index. The two series move quite closely together until the end of the 1980s. Year 1992 in the PSID is characterized by a very large increase in the real wage that has no correspondence in the actual series. We regard this as reflecting data problems and use a dummy to control it.

Figure 1. Sample demographics.

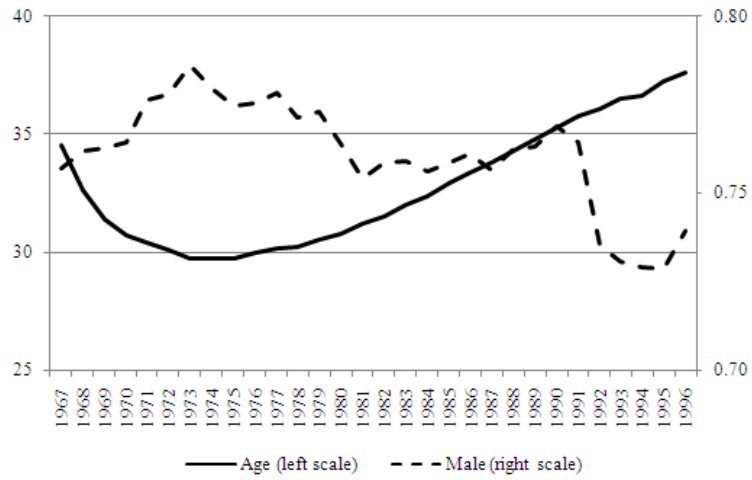


Figure 2. Hours per workers growth rate

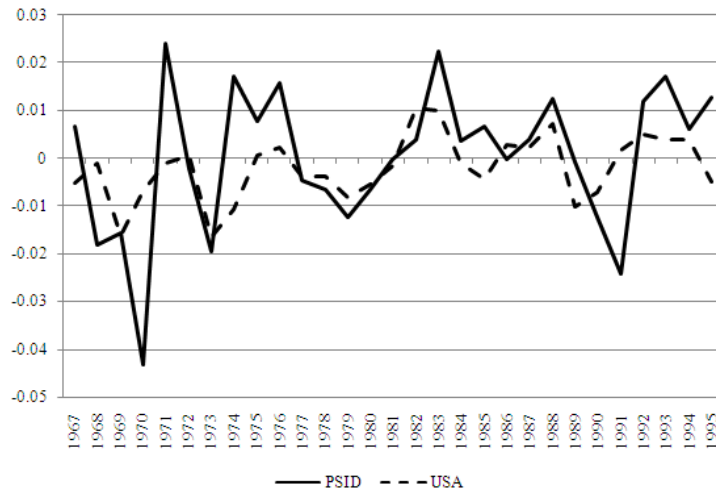


Figure 3. Employment growth rate

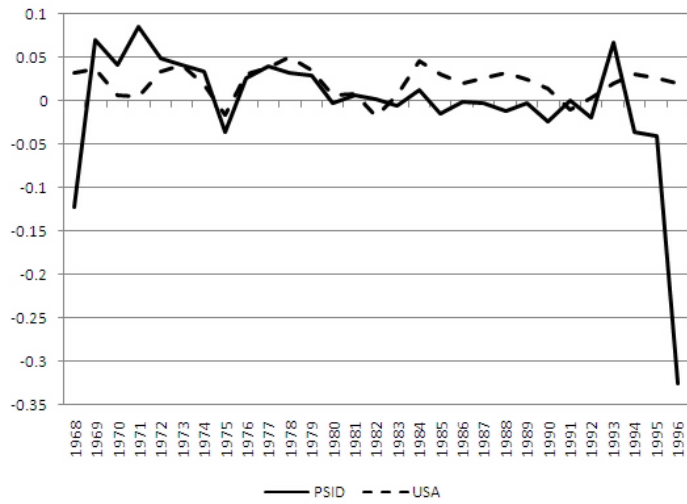


Figure 4. Average real wage growth rate

