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## **Documentos de Trabajo**

Multiple job holding:  
the artist's labor supply approach

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# **Multiple job holding: the artist's labor supply approach**

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## **Resumen**

En este trabajo se analiza un modelo de oferta laboral en el que los individuos maximizan una función de utilidad que depende del tiempo libre, el consumo y las horas dedicadas a una actividad que se denomina “artística”. Esta actividad puede generar ingresos que dependen en forma no lineal del tiempo que se le dedica. Asimismo el individuo puede trabajar en el mercado (actividad que no genera bienestar por sí misma) a cambio de un salario por hora, y recibir ingresos no relacionados con el uso de su tiempo. Se obtienen condiciones que separan dos grupos de individuos, los artistas de tiempo completo y los de tiempo parcial, derivando sus funciones de oferta de horas en ambas actividades. El modelo es contrastado empíricamente usando una muestra de músicos pertenecientes a una sociedad de administración de derechos de intérprete de Uruguay.

## **Abstract**

This paper analyzes a labor supply model in which individuals maximize a utility function that depends on leisure time, consumption and time devoted to an activity that is termed “artistic”. This activity may generate income that depends non linearly on hours dedicated to it. The individual can also work in the labor market (an activity that does not increase utility by itself) in exchange for an hourly wage, and obtain income not related to hours. Conditions are obtained that sort individuals in two groups, part time and full time artists, deriving their labor supply functions in both activities. The predictions of the model are tested empirically using a sample of musicians from a Uruguayan performing rights society.

JEL Codes/Códigos JEL:

J22: Time allocation and labor supply (Asignación del tiempo y oferta de trabajo);

Z11: Economics of the Arts and literature (Economía del arte y la literatura).

Keywords: Labor supply; time allocation; artist’s labor supply; cultural economics.

Palabras clave: Oferta de trabajo; asignación del tiempo; oferta de trabajo de los artistas; economía de la cultura.

## 1) Introduction

This paper presents a generalization of the static labor supply model, in which an individual may hold two jobs, one of which brings utility in itself; we term it “artistic job”. Additionally, we allow for earnings in the artistic job to be non linear in hours dedicated to it. Two strands of literature relate to this problem, the “moonlighting” or dual job holding, and the artists’ labor supply literature.

The traditional approach in the moonlighting literature views the decision to hold a secondary job as resulting from a constraint on hours worked in the primary job (Shishko and Rostker, 1976). A paper by Smith Conway and Kimmel (1997) outlines a model in which workers perceive both jobs as heterogeneous. Their model is a utility maximization one, in which hours worked on both jobs enter the utility function.

Since the beginning of cultural economics as a research area with Baumol and Bowen’s (1966) seminal paper, there has been a quest for a theoretical model of how artists supply labor to arts and non-arts markets.<sup>2</sup> An early unpublished reference is Hamermesh (1974) who studies the behavior of the traditional labor supply model in the case in which individuals enjoy their work. The current standard reference in cultural economics is Throsby’s (1994) work-preference model tries to provide a theoretical model on artist labor decisions and is probably the better known actual reference to the topic. This author presents the problem of an agent that excerpts utility from consumption and artistic work and has a time constraint and an income constraint.

Throsby makes the extreme assumption that artists’ are overwhelmingly motivated to create art, only care about a minimum consumption bundle and do not care at all about leisure. Artists would only choose non-arts work to complement artistic income in order to attain the minimum consumption level. The resulting work-preference model is not really a utility maximization model; the solution of the model is an operation on the budget constraint. Rangers and Madden (2000) label this model “the strong version”. The literature has also worked with a weaker version presented for instance in Caserta and Cuccia (2001), where the minimum consumption condition is not imposed and hence there is actually a utility maximization problem. All of these versions do not consider leisure in the utility function; hence changes on arts work translate unambiguously into non arts labor supply.

On empirical grounds, Filer (1986) suggests that the starving artist is more a myth than a real life feature. Artists as everybody else care about consumption and therefore it is possible that an increase in non-arts market wage may induce artists to supply less arts time and to consume more. Throsby’s (1994) model predicts that an increase in the non-arts wage will induce an increase in arts labor supply, but his model’s framework does not accommodate the whole set of possible artist’s time allocations. One of the main departures of our model with respect to this literature is that (besides arts work time) we allow for leisure in the utility function and time constraint of agents. Caserta and Cuccia (2001) point

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<sup>2</sup> Useful surveys include Blaug (2001), Throsby (1994b) and Menger (1999).

the importance of considering the intertemporal dimension of labor supply and analyze possible routes toward a dynamic theory of artist labor supply. Though dynamic analysis is undoubtedly relevant, we still lack a formal model with optimizing agents of artist labor supply.

Artists may be a clear example of workers that love their work. However, though passionately dedicated to creation, they may also distinguish between life and art. Hence, somewhat paradoxically, we rely on a conventional model, closer to home production and labor supply models, to provide valuable insights on the behavior of this unconventional occupational group. The implications are considerable, since arts policy relies massively on incentives to personal dedication, and its impacts are carried out decisively through entry and exit decisions. The precise behavioral response assessment and the possible existence of “marginal artists” are key elements of policy design. Our results are also interesting to other activities or occupations in which the “doing what you love” ingredient is important, such as the academic field or volunteer work.

This paper contributes to the literature in several ways. First, it solves the problem of a utility maximizing agent that cares about consumption, leisure and arts work. Second, it allows artistic income to be a non linear function of arts labor and of market perceived artistic quality. Third, it tests the empirical predictions of the model.

## 2) The model

There are two differences between our utility maximizing problem and traditional labor supply models. The first is that the individuals derive pleasure from arts time and therefore it is an argument in the utility function. This is a feature of Throsby’s (1994) model, however unlike Throsby’s, our model includes leisure as a separate argument. In the specific case of artists, it may be argued that the limit between leisure and work is tenuous, i.e. contemplating a beautiful sunset provides inspiration and valuable input for artistic work. However, novelist Philip Roth has stated that art must draw on life, and complete dedication to art led him to miss life.<sup>3</sup> We keep this distinction trying to capture the presence of all other time allocation uses.<sup>4</sup> Leisure is not identified with arts time.

The individuals have two sources of income: the non arts and the arts activities. It has been pointed out that artistic income may not take the form of an hourly wage, i.e. artistic earnings may not be linear in the hours supplied to arts work. Throsby (1994) comments that this can be the case in artists that produce works that are to be sold as such. In the case of performing artists, they may face downward sloping demand curves for the number of performances supplied; hence more output might be linked to decreasing marginal income.

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<sup>3</sup> "It was the interests in life and the attempt to get life down on the pages which made me a writer - and then I discovered that, in many ways, I am standing on the outside of life". Philip Roth, interview in *The Guardian*, London, Dec 14<sup>th</sup>, 2005.

<sup>4</sup> Uruguayan writer Mario Levrero documents along a novel the subtle micro psychological changes that a writer undergoes since he receives a grant that will allow him to finally write freely his work, and the many conflicts surrounding an artist’s time allocation, particularly the transitions between writing and non writing time. Mario Levrero, *La novela luminosa (The Enlightening Novel)*, Alfaguara, 2005.

Moreover, artistic ability may be seen as a fixed factor so arts time is subject to diminishing returns.<sup>5</sup>

Therefore in our model we allow arts income to be a non linear function of arts hours and of market perceived artist quality. This has been suggested before but we know of no paper in which it has been explored neither theoretically nor empirically. This also separates our model from that of Smith and Kimmel (1998), in which hours of both jobs enter the utility function and wage schedules are linear in both cases.

In our model an individual will maximize a concave utility function  $U(c, l, h_A)$  where  $c$  represents an aggregate consumption basket,  $l$  stands for leisure and  $h_A$  is time devoted to art.<sup>6</sup> The time constraint implies that total time ( $T$ ) has to be divided between leisure ( $l$ ), arts time ( $h_A$ ) and non arts work ( $h_N$ ). In the budget constraint, without loss of generality, we normalize the price of the consumption bundle to 1. Income is derived from three sources: working in the non arts labor market at a wage rate  $w$ , arts work, and non-hours related sources of income. Arts income is assumed to depend positively on arts hours and a measure of market perceived quality. We understand by market perceived quality all those features of artistic output that can potentially shift the arts earnings, and not the artists' perceived quality or critic's aesthetic valuation. We specifically allow for non-linearities in this source of income.

Income not related to working hours is typically associated with rents from assets or transfers. An artist may also receive royalties for her past creations not necessarily related to current artistic effort. Since they would enter equally in the utility function, we consider the combined effect of the sum of all non labor income,  $V$ .

Formally, the maximization problem would be:

$$\begin{aligned} & \text{Max} \quad U(c, l, h_A) \\ & c, l, h_A \end{aligned}$$

Subject to:

$$w(T - l - h_A) + f(h_A, \theta) + V = c$$

$$l + h_A \leq T$$

$$l \geq 0; \quad h_A \geq 0; \quad c \geq 0$$

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<sup>5</sup> In the long run, arts activity has a human capital dimension, dedication enhances ability, etc. We only tackle the static problem.

<sup>6</sup> The inclusion of arts hours in the utility function is a formalization of the idea of "labor of love" or psychic income –which dates back to Adam Smith- and is presented for instance in Menger (1999) and Papandrea and Albon (2004).

**Assumptions (1):**

$$f_l > 0, \quad f_{ll} < 0, \quad f_2 > 0, \quad f_{l2} > 0$$

$$U_c(\cdot) > 0, \quad U_l(\cdot) > 0, \quad U_{h_A}(\cdot) > 0$$

$$U_{cc}(\cdot) < 0, \quad U_{ll}(\cdot) < 0, \quad U_{h_A h_A}(\cdot) < 0$$

or  $\frac{\partial U(X)}{\partial^2 X}$  negative semidefinite, with  $X = (c, l, h_A)$

Assumption (1) implies that arts income is increasing in arts hours at a decreasing rate (concavity), and it is increasing in the market perceived quality. Hours and market quality are complements (artists more attractive to the market have larger marginal income per hour). We also assume that Inada conditions hold, ruling out corner solutions, for consumption, leisure and arts time. Formally:

$$\lim_{c \rightarrow 0} U_c(\cdot) = \infty; \quad \lim_{l \rightarrow 0} U_l(\cdot) = \infty; \quad \lim_{h_A \rightarrow 0} U_{h_A}(\cdot) = \infty.$$

The first two are standard in utility maximization models, and the third is a natural extension of this criterion.<sup>7</sup>

Given this conditions, the problem can be stated as maximizing the following Lagrangian:

$$\ell = U(c, l, h_A) + \mu_0(c - w(T - l - h_A) - f(h_A, \theta) - V) + \mu_1(T - l - h_A) + \mu_2 l + \mu_3 h_A + \mu_4 c$$

where the first order Kuhn Tucker conditions are as follows:

$$\frac{\partial \ell}{\partial c} = 0 \quad ; \quad \frac{\partial \ell}{\partial l} = 0 \quad ; \quad \frac{\partial \ell}{\partial h_A} = 0$$

$$\frac{\partial \ell}{\partial \mu_0} = 0; \quad \frac{\partial \ell}{\partial \mu_1} \geq 0; \quad \frac{\partial \ell}{\partial \mu_2} \geq 0; \quad \frac{\partial \ell}{\partial \mu_3} \geq 0; \quad \frac{\partial \ell}{\partial \mu_4} \geq 0$$

$$\mu_0 \geq 0; \quad \mu_1 \geq 0; \quad \mu_2 \geq 0; \quad \mu_3 \geq 0; \quad \mu_4 \geq 0$$

$$\mu_0 [c - w(T - l - h_A) - f(h_A, \theta) - V] = 0$$

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<sup>7</sup> If this condition does not hold the model besides the full time and part time artist, could potentially nest a third case, the non artist, corresponding to the standard static labor supply model.

$$\mu_1(T-l-h_A)=0; \quad \mu_2 l=0; \quad \mu_3 h_A=0; \quad \mu_4 c=0$$

Inada conditions imply that at the optimum  $l > 0$ ;  $c > 0$  and  $h_A > 0$ , so  $\mu_2, \mu_3$  and  $\mu_4$  must equal 0. Like all static maximization problems where agents enjoy consumption, they spend their entire budget. For any arts and non arts hours choice, implying certain income, agents do not derive utility by saving. Thus, the budget constraint will be satisfied with equality, so we do not worry about  $\mu_0 \geq 0$ . Our problem simplifies to:

$$U_c + \mu_0 = 0 \tag{1};$$

$$(T-l-h_A) \geq 0; \quad \mu_1 \geq 0; \quad \mu_1(T-l-h_A) \geq 0$$

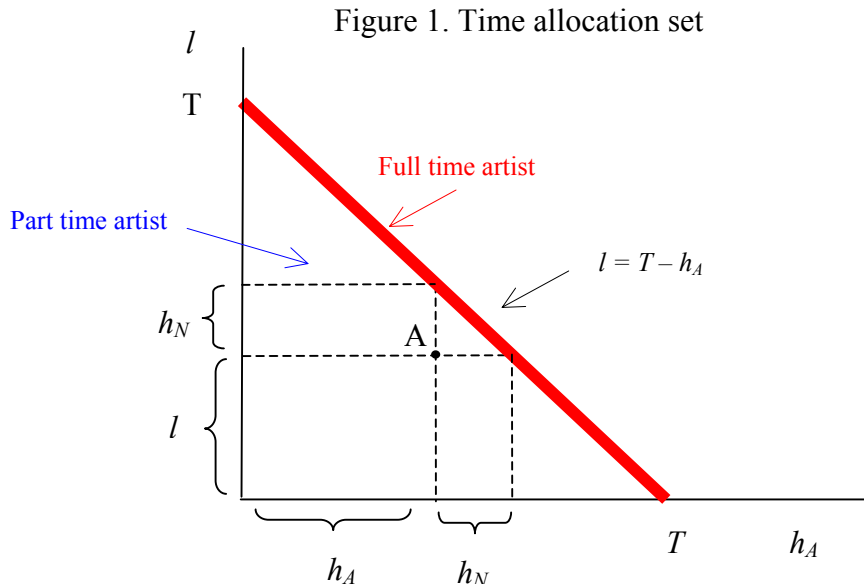
$$U_l + \mu_0 w - \mu_1 = 0 \tag{2};$$

$$U_{h_A} + \mu_0(w - f_l) - \mu_1 = 0 \tag{3};$$

$$c - w(T-l-h_A) - f(h_A, \theta) - V = 0 \tag{4}.$$

### 3) Graphic representation

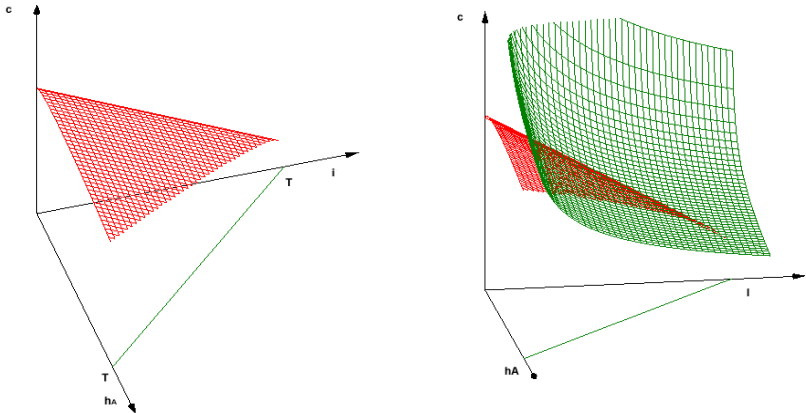
A simple two dimensional representation of the time constraint is a triangle with sides of length  $T$  and its vertex at origin in the plane  $(l, h_A)$ . The individual should choose a point where  $l + h_A \leq T$ . All points over the straight line  $l = T - h_A$  correspond to full time artists and imply  $h_N = 0$ . An individual in a point like A defines  $l$  and  $h_A$ , and then  $h_N$  is uniquely determined by the distance to the constraint.





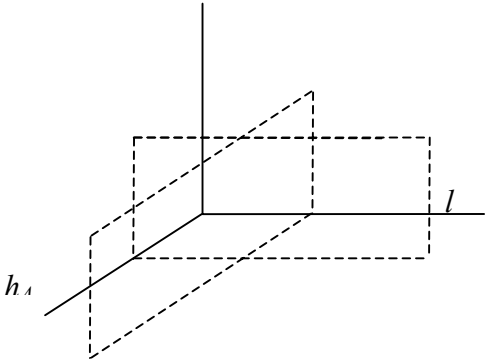
Representation of individual choices could use a three dimensional graph in space  $(c, l, h_A)$ . To each point in the triangle of feasible time allocations it is associated a point in the budget surface given by  $c = w(T - l - h_A) + f(h_A, \theta) + V$ . Given  $h_A$ , increases in  $l$  translate in reductions in non arts work time valued at  $-w$ , the slope of a slice of the budget surface parallel to the  $l$  axis. Given  $l$ , increases in  $h_A$  correspond to reductions in non arts work time valued at  $w$ , but arts income is generated at a rate  $f(h_A, \theta)$ , so the slope of a slice of the budget surface parallel to the  $h_A$  axis is equal to the difference between  $f_l$  and  $w$ . It can be the case that  $f_l > w$  for all values of  $h_A$ , in which case the slope will always be positive, and will always be negative if conversely  $w > f_l$ . Finally, a third case is when this slope is initially positive and becomes negative after a certain threshold. Constant utility levels define indifference surfaces in the space  $(c, l, h_A)$ . Such surfaces will be convex towards the origin. An interior solution implies the tangency between the budget surface and an indifference surface in the space  $(c, l, h_A)$ .

Figure 2. Budget constraint and agents optimum 3D



Choices can also be represented through subsets of the space  $(c, l, h_A)$  in which one of the variables is kept constant. Graphically, this would yield “slices” of the original three-dimensional graph which are parallel to the axes.

Figure 3. Simplified 3D representation



#### 4) The full time and part time artist cases

Two cases are of interest to this paper, the full time and the part time artist, characterized as follows:

*Part time artist:*  $h_N > 0, h_A > 0$

*Full time artist:*  $h_N = 0, h_A > 0$

##### 1. Part time artist:

As  $h_N > 0$ ,  $T - L - h_A > 0$ . Then  $\mu_l = 0$ .

From (1) and (2) we get

$$\frac{U_l}{U_c} = w \quad (5)$$

From (1) and (3)

$$U_{h_A} - (w - f_l(\cdot))U_c = 0 \Rightarrow \frac{U_{h_A}}{U_c} = w - f_l(\cdot) \quad (6)$$

Equation (6) states that for a part time artist, marginal utility of arts hours should equal the loss in marginal consumption due to switching from non arts to arts work. Euler conditions equating the marginal rates of substitution and marginal rates of transformation are obtained for consumption and leisure (equation (5)) and consumption and arts time (equation (6)). Combining (5) and (6):

$$U_l = U_{h_A} + U_c f_l(\cdot) \quad (7)$$

Utility of one more hour dedicated to leisure should equal the direct utility of one more hour dedicated to art plus the marginal utility of consumption derived from the increase of arts income.

Finally we restate the budget constraint

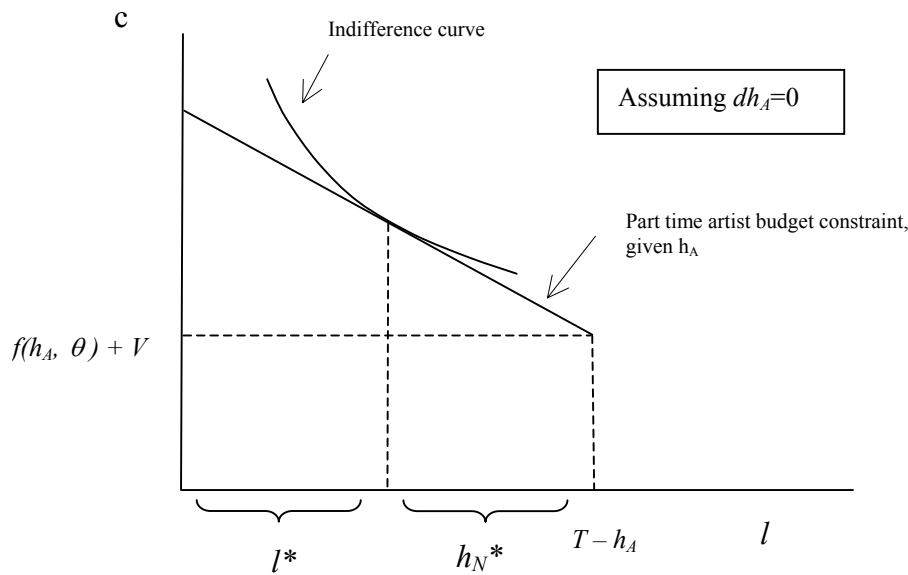
$$c = w(T - l - h_A) + f(h_A, \theta) + V \quad (8)$$

Equations (7), (8) and (9) determine  $c, l, h_A$ .

The case in which the individual would choose an interior point is displayed in figure 4. A

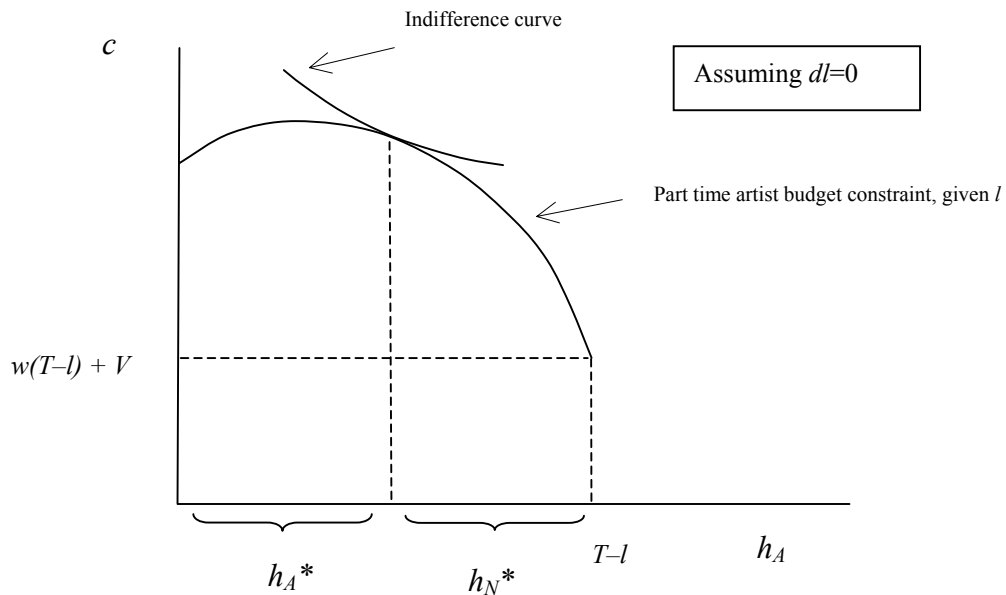
slice of the plane  $(l, c)$  would graph as follows.

Figure 4. Part time artist,  $c$ - $l$  trade off given  $h_A$



The slope of the indifference curve is  $-U_l/U_c$  and the slope of the budget constraint is  $-w$ . The tangency point corresponds to equation (7) for part time artists determining leisure and by difference non arts hours. Figure 5 shows a slice of the  $(h_A, c)$  plane for a given value of leisure.

Figure 5. Part time artist,  $c$ - $h_A$  trade off given  $l$



The slope of the budget corresponds to the difference  $f_l(\cdot) - w$ , which in this case was drawn to increase initially and then to decrease after a certain point. The slope of the indifference curve pictured is  $-U_{h_A}/U_c$ . The tangency point corresponds to equation (6) for part time artists determining arts hours and by difference non arts hours.

## 2. Full time artist:

By definition of full time artist  $h_N = 0$  and  $h_A = T - L$ .

As in the previous two cases we can use (1) and (2) to eliminate the Lagrange multiplier obtaining:

$$U_l - U_c w = \mu_l > 0 \Rightarrow \frac{U_l}{U_c} > w \quad (9)$$

From (1) and (3) we get

$$U_{h_A} - U_c w + f_l(\cdot) U_c = \mu_l > 0 \quad (10)$$

and from (10) and (11) we find as in equation (8):

$$U_l = U_{h_A} + U_c f_l(\cdot) \quad (11)$$

The budget constraint simplifies to:

$$c = f(h_A, \theta) + V \quad (12)$$

Budget constraint (12), equation (11) and condition  $T = l + h_A$  uniquely determine  $c, l, h_A$ .

For full time artists, we have a special indifference map. Linked by the time constraint, leisure and arts hours are no longer independent. A full time artist is located exactly over the segment TT in figure 1, i.e.  $T = l + h_A$ . This determines in the  $(c, h_A)$  plane, a strictly increasing budget set, with slope  $f_l$ . Indifference curves can be alternatively defined between the pairs of goods  $(c, l)$  or  $(c, h_A)$ , since the condition  $T = l + h_A$  implies that choice of  $l$  uniquely determines  $h_A$  and vice versa. Our three variable space collapses to a two-dimensional one, and  $U(c, l, h_A)$  becomes  $U(c, h_A)$ .

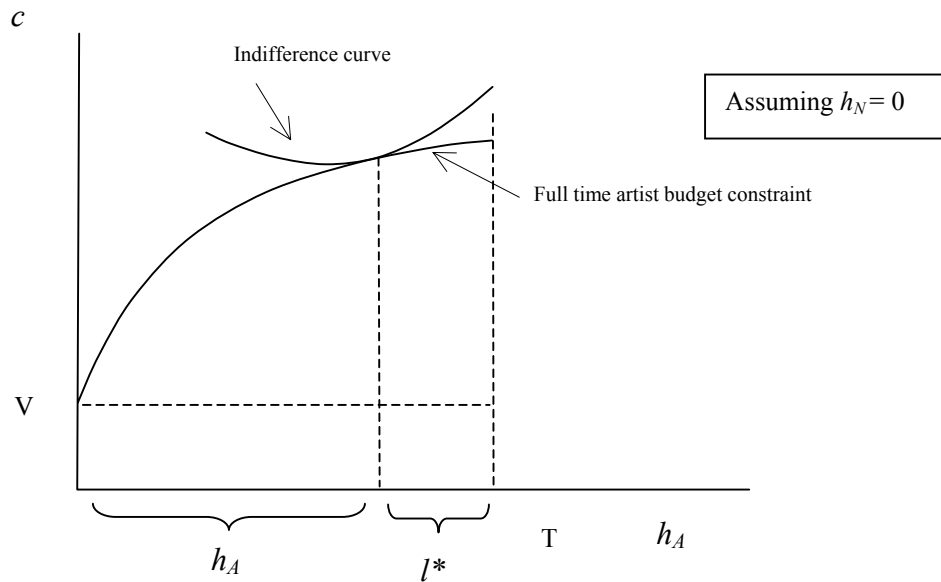
For the full time artist, at the optimum  $U_c dc + U_l dl + U_{h_A} dh_A = 0$ . As  $-dl = dh_A$ , then it must hold  $U_c dc + (U_{h_A} - U_l) dh_A = 0$ . Then the slope of an indifference curve in the plane  $(c, h_A)$  is given by

$$\frac{dc}{dh_A} = \frac{(U_l - U_{h_A})}{U_c}$$

In this case indifference curves are not monotonic. For small  $h_A$ , marginal utility of arts work net of leisure is positive, hence  $U_{h_A} - U_l > 0$  and the indifference curve in the  $(h_A, c)$  space has a negative slope. However, for large values of  $h_A$ ,  $l$  would be relatively small and the opposite will be true:  $U_l - U_{h_A} > 0$ . As from equation (10) we know that  $(U_l - U_{h_A})/U_c = f_l > 0$  i.e. the optimum must lie in the region where the slope of the indifference curve is positive.

Indeed, this is the region in which there is a true trade off for the artist. To the left of the minimum of the indifference curve the artist gains by reducing leisure, since obtains larger consumption but also the trade off of time is advantageous. At the minimum of the indifference curve, it holds that  $dc/dh_A = 0 \Leftrightarrow U_{h_A} = U_l$ . Given concavity, to the left it holds that  $U_{h_A} > U_l$ , i.e. for each hour subtracted to leisure to dedicate it to arts work, she is gaining more utility from more arts time than what loses by less leisure time. Only when art time is already large in time allocation, the trade off appears.

Figure 7. Full time artist  $c$ - $h_A$  trade off



### 3. Summary

Table 1 summarizes the characteristics of each case.

Table 1 Characteristics of optima, part time and full time artists	
Part time artists	Full time artists
$\frac{U_l}{U_c} = w$ (5)	$\frac{U_l}{U_c} > w$ (9)
$\frac{U_{h_A}}{U_c} = w - f_l(\cdot)$ (6)	$\frac{U_{h_A}}{U_c} \geq w - f_l(\cdot)$ (10)
$\frac{U_l - U_{h_A}}{U_c} = f_l(\cdot)$ (7)	$\frac{U_l - U_{h_A}}{U_c} = f_l(\cdot)$ (11)
$c - w(T - l - h_A) - f(h_A, \theta) - V = 0$ (8)	$c - f(h_A, \theta) - V = 0$ (12)

Both types of agents have in common the equalization between the difference of marginal rates of substitution (between leisure and consumption and arts time and consumption) and marginal arts income. However, in the case of full time artists, they do not consider non arts market because: 1. marginal rate of substitution between leisure and consumption is larger than the foregone non arts wage, and 2. marginal rate of substitution between arts time and consumption is larger than the foregone difference between non arts wage and marginal arts income. Hence, they differ in their budget constraints, since the full time artist will not have non arts labor income.

## 5) Comparative static

Some statements that do not require more restrictive assumptions are the following (proofs are given in the appendix):

### ***Proposition 1***

*Under A1,*

- a. Marginal changes in  $w$  do not modify the behavior of full time artists.*
- b. Part time artists could be affected both by changes in  $w$  and changes in  $\theta$ .*

This can be stated in terms of the traditional labor supply framework: changes in factor returns induce supply increases (substitution effect between consumption and leisure) or supply reductions (income effect, consumption and leisure). This applies both to “leisure consumption” and to “arts time consumption” (as long as  $h_A$  is within the relevant range).

### ***Reservation wage***

Part a. of proposition 1 refers only to marginal changes in wages. Should wages increase enough, it is possible that a full time artist becomes a part time one.

**Proposition 2**

Under A1, there is a reservation wage  $w_R$  that -ceteris paribus- makes an individual indifferent between being a full time or part time artist. The reservation wage  $w_R$  depends positively both on non labor income  $V$  and on market attractiveness  $\theta$ .

In what follows, assuming a definite functional form for the individual's utility function allows obtaining some interesting properties of the arts and non arts labor supply functions. In order to derive them we assume that the utility function is of the CES type.

**Assumption (2).**  $U(c, l, h_A) = (x_1 c^\rho + x_2 l^\rho + x_3 h_A^\rho)^{\frac{1}{\rho}}$

The CES utility function is more restrictive than a generic utility function but retains generality, as it includes as specific cases the linear, Cobb-Douglas and Leontieff types of utility functions (when  $\rho = 1$ ,  $\rho \rightarrow 0$ , and  $\rho \rightarrow -\infty$  respectively). It is natural to assume that the elasticity of substitution is non-negative and since it is equal to  $\frac{1}{1-\rho}$ , it must be that  $\rho \leq 1$ . Symmetry is assumed for expositional purposes; i.e. different degrees of complementarities could be analyzed using a nested two-level CES function.

Equation (8) shows that for an interior solution we need  $w - f_1 > 0$ . This condition is weaker than Throsby's (1994) assumption that the wage in the labor market must be higher than the wage in the artistic market. It only implies that evaluated at the optimal artistic hours  $h_A^*$ , the hours-marginal arts income is lower than the labor market hourly wage.

Using such utility function specification, it is straightforward to prove the following propositions (proofs are given in the appendix).

**5.1 Part time artists' results****Proposition 3**

Under A1 and A2, for a part time artist:

- a. Leisure is increasing in  $V$ .
- b. Arts hours supply is increasing in  $V$ .
- c. Non-arts market hours supply is decreasing in  $V$ .

**Proposition 4**

Under A1 and A2, for a part time artist:

- a. An increase in the non-arts wage has an ambiguous effect on leisure.
- b. An increase in the non-arts wage has an ambiguous effect on arts market hours supply.
- c. An increase in the non-arts wage has an ambiguous effect on non-arts market hours supply.

**Proposition 5**

Under A1 and A2, for a part time artist:

- a. An increase in market perceived quality  $\theta$  has an ambiguous effect on leisure.
- b. Arts market hours supply is increasing in market perceived quality  $\theta$ .
- c. Non-arts market hours supply is decreasing in market perceived quality  $\theta$ .

**Assumption (3).**  $f_{12} \frac{h_A}{f_2} \leq 1 - \rho$

Since  $f_2$  is the market quality-marginal income from the artistic market, assumption 3 restricts the elasticity of market quality-marginal income with respect to hours to be below a certain threshold. It is not problematic if the utility function is Cobb-Douglas or Leontieff but for a linear utility function it would imply a negative elasticity.

**Proposition 6.**

Under A1 and A2, for a part time artist, A3 is a sufficient condition for leisure demand to be increasing in market perceived quality  $\theta$ .

**Income and substitution effects, part time artists**

The effects of changes of non arts wages, non labor income and arts earning potential on arts and non arts hours can be interpreted as modified versions of the income and substitution effects in the traditional labor supply model (see proofs of propositions 3 to 6).

The derivatives of leisure and arts time with respect to non labor income are positive, and have a direct interpretation as a pure income effect (both are goods). On the contrary, the derivative of non arts time with respect to non labor income is negative, exactly as in the labor supply income effect result.

The effect of non arts wage in arts time in leisure and arts time cannot be signed; however it can be decomposed as the sum of an always negative income effect and a substitution effect of ambiguous sign. This leads in turn to having an always negative income effect of non arts wage in non arts time but a substitution effect that cannot be signed.

**5.2. Full time artists' results****Proposition 7.**

Under A1 and A2, for a full time artist:

- a. Arts hours supply is an increasing function of  $V$
- b. Arts hours supply is an increasing function of  $\theta$

Summarizing, we have obtained clear predictions as to the effect on time allocation of part



time and full time artists of the exogenously given outside market opportunities, unearned income and arts earning potential. In what follows we try to test such implications using a small sample of artists.

## 6) Application

### a) Data

Our data were obtained from a survey of a population of musicians members of a performing rights administration association. A sample of 474 artists was obtained from the records of the Uruguayan Society of Performing Artists (SUDEI) that collects on their behalf the performing rights from their recorded performances. Data were obtained directly from the artists in the sample, which were interviewed at their homes. The sample was stratified across several dimensions, including age, gender, artistic occupation and type of musical genre. Artistic occupation is defined in terms of largest time allocation. Musical genre was self defined. Table 2 shows basic descriptive statistics.

Table 2 Sample of performing musicians		
Main artistic occupation	Cases	%
Composer	22	5.6
Arranger	12	3.1
Director	20	5.1
Producer	10	2.6
Player	190	48.5
Singer	87	22.2
Singer-songwriter	41	10.5
Improviser	1	0.3
Other	9	2.3
Total	392	100.0
Musical genre	Cases	%
Classical	53	13.5
Typical (tango)	33	8.4
Folklore	17	4.3
Popular	86	21.9
Tropical	51	13.0
Jazz	17	4.3
Brazilian	3	0.8
Murga	32	8.2
Carnival	11	2.8
Afro Uruguayan	22	5.6
Rock	31	7.9
Theater	3	0.8
Film or TV	6	1.5
Other	18	4.6
Not apply	9	2.3
None	392	100.0
Source: Survey of performing musicians, 2001		

In table 3 we provide descriptive statistics for incomes, hours, labor and personal background variables for the musicians in our sample. Averages hide large heterogeneity between full time and part time artists, as well as between all year artistic workers and seasonal performers. We present separately data for full time artists and multiple job holders.

Table 3 Performing artists sample Descriptive statistics (averages)		
	Full time artists	Part time artists
Arts income	9176.8	3581.7
Non arts income		5889.4
Nonlabor income, arts assets ( $V_A$ )	787.8	783.2
Nonlabor income, non arts assets ( $V_n$ )	70.8	149.2
Arts hours	189.2	104.9
Non arts hours		141.8
Gender (% male)	85.4%	85.0%
Age	39.1	42.8
Art experience years	20.9	23.2
Arts formal education	64.9%	56.0%
Highest education attained secondary	48%	44%
Highest education attained technical	6%	12%
Highest education attained tertiary	41%	38%
Private sector worker in arts job	11%	15%
Public sector worker in arts job	24%	4%
Cooperative worker in arts job	8%	19%
Owners in arts job	5%	11%
Self employed in arts job	53%	50%
Source: Survey of performing musicians, 2001. Incomes are measured in October 2001 Uruguayan pesos; Hours and incomes are monthly averages.		

Our artists' database shares the same kind of features that artists' data generally have. Censuses usually classify workers by occupation based on the largest contribution to labor income, and in many cases part time artists go undetected if there is not data on the second occupation.<sup>8</sup>

In our case, since we have affiliates from a performing rights society, we have a bias towards those artists that do have an incentive to become members, i.e. those that have generated performing rights that arise from recorded performances. An additional requisite

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<sup>8</sup> While in the Uruguayan Household survey sample only about 8% of workers hold a secondary job, in our artists' sample this fraction is about 50%.

to be admitted is to show proof of public performances. This biases our data towards those more established artists.

Our recorded income values do not place the artists in our sample in the lowest quintiles of labor income distribution (as the “starving artist” view would suggest). Median artistic income (measured in monthly terms, correcting for seasonal activity) for full time artists is in our sample 6750 pesos, above median main occupation labor income for the October 2001 Uruguayan Household Survey, 6112 pesos. Artists in our sample seem to be more in the middle class than in the starving side of society.

## **b) Econometric strategy**

We intend to provide evidence to assess if our model is useful to organize the information on artist’s time allocation. To do so we undertake the estimation of the parameters of the supply functions of hours in both the arts and non arts markets, particularly the impacts of non earned income, and non arts wages on hours dedicated to arts and non arts work. These will help to evaluate the effects of public subsidies to arts activity and provide valuable evidence regarding the extent to which arts work would react to changes in the economic environment and outside opportunities.

Our model leads us to consider separately the estimation of supply functions that are different in nature for part time and full time artists. The two main differences are that, since for full time artists the ratio of marginal utilities of leisure and consumption is larger than the non arts wage, the non arts wage does not feature in the arts hours supply function, and that a non arts hours labor supply function does not apply. However, part time and full time artists observe the same set of opportunities and constraints  $w, \theta, V$  and take the decision that sorts them into one of the two groups. This will be reflected in our sample selection estimation procedure.

For part time artists, our model yields two labor supply equations in arts and non arts activities, respectively:

$$h_A^p = h_A(w, V, \theta)$$

$$h_N^p = h_N(w, V, \theta)$$

We expect  $V$  to have a negative impact in non arts hours  $h_N$  and a positive effect on arts hours  $h_A$ , whereas perceived arts market quality  $\theta$  should impact positively on arts time and negatively on non arts time.

Our model does not predict the net effect of substitution and income effects of non arts

wage  $w$  changes in either supply equation; hence it remains to be empirically evaluated. Throsby (1992) presents an estimation of labor supplies in both markets which yields a positive effect of each of the wages on hours supplied in its own market and a negative effect in hours supplied in the other. In his paper, data are not wages but earnings that in turn are divided by hours to obtain “hourly earnings”. Further, the dependent variables are not hours but the proportions of time worked in each market as a fraction of total work time, hence arts work is  $1$  minus non arts work, and this affects the coefficient signs (an increase in arts work time at the expense of leisure leaving non arts time unchanged would translate into a reduction of the non arts work proportion of total time). Rengers and Madden (2000) adapt Throsby’s model and present an estimation in which hours and hourly earnings equations are estimated using Throsby’s data. We believe that our specification allows for a more precise answer as to the effect of non arts wage in arts work time.

We will estimate the following system of equations for part time artists:

$$h_N = \alpha_2 + \beta_2 w_i + \gamma_2 \theta_i + \delta_2 V_i + \varepsilon_{2i} \quad (12)$$

$$h_A = \alpha_1 + \beta_1 w_i + \gamma_1 \theta_i + \delta_1 V_i + \varepsilon_{1i} \quad (13)$$

We do not observe  $\theta_i$ , and we postulate that  $\theta_i$  is a function of a set of observable artistic individual characteristics plus an unobservable, random term that we may term “talent” or “box office appeal”.

$$\theta_i = aHK_{ai} + bEXP_{ai} + cEXP_{ai}^2 + \sum_j d_j g_{ji} + \sum_k e_k Oc_{ki} + fGen_i + v_i$$

where  $HK_a$  is artistic human capital, measured by formal artistic education level attained,  $EXP_a$  is years of artistic work experience,  $g_j$  are dummy variables equal to one if the artistic activity belongs to each musical genre,  $Oc_k$  are dummy variables, equal to one for each of the artistic occupations and  $Gen_i$  is a gender dummy equal to one for males.

Substituting the following regression equations are obtained:

$$h_A = \alpha_1 + \beta_1 w_i + \gamma_1 \left[ aHK_{ai} + bEXP_{ai} + cEXP_{ai}^2 + \sum_j d_j g_{ji} + \sum_k e_k Oc_{ki} + fGen_i + v_i \right] + \delta_1 V_i + \varepsilon_{1i} \quad (14)$$

$$h_N = \alpha_2 + \beta_2 w_i + \gamma_2 \left[ aHK_{ai} + bEXP_{ai} + cEXP_{ai}^2 + \sum_j d_j g_{ji} + \sum_k e_k Oc_{ki} + fGen_i + v_i \right] + \delta_2 V_i + \varepsilon_{2i} \quad (15)$$

Only a fraction of our sample holds non arts jobs. Around 51% of the sampled musicians hold only arts jobs, hence present corner solutions with respect to entry in the non arts labor market.

Ordinary least squares estimation of the coefficients in (15) using the part time artists sub

sample will be biased due to non random sample selection. Heckman (1976, 1979) proposed procedures to obtain a corrected estimation in sample selection cases. We estimate a first stage non arts labor market participation model for part time artists. The condition that is implied by participation in such market is  $f_l < w$  (from second row of Table 1). Hence we use a probit estimation where the probability of having nonzero non arts hours is modeled as a function of the variables that determine if  $w > f_l$ , i.e. the determinants of non arts wages and arts earnings. Let us assume that non arts wages are determined by the set of variables usually included in standard human capital models, basically education and experience. Participation will also depend on variables that account for preferences, such as demographic indicators as gender, household head condition, if the artist has children, etc. All the variables that determine  $\theta_i$  are included as potentially affecting the probability of being a part time artist. Our estimated equation will be:

$$P(h_N > 0) = g(HK_n, Age, Gen, HH, Ch, HK_{ai}, EXP_{ai}, g_{ji}, Oc_{ki}) \quad (16)$$

where  $HK_n$  is non arts human capital,  $Age$  and  $Gen$  are age and gender,  $HH$  is a dummy variable for household heads,  $Ch$  takes value 1 if the artist has children. We can then obtain the inverse Mill's ratio and estimate sample selection corrected arts and non arts hours equation for the part time artist's sample. Using a probit functional form implies that the selection term is a nonlinear function of the selection equation right hand side variables, and hence identification of the second stage equation is guaranteed. In order not to rely only on normality assumptions implied by the probit, an exclusion restriction is also desirable for identification, i.e. some regressors in the non arts participation equation are not in the hours equations, which in our case holds. We then estimate the sample selection corrected equations (14) and (15) using the part time artists sample.

We do also estimate for full time artists the (also sample selection corrected) equation

$$h_A^f = h_A(V, \theta)$$

in which the coefficient of non labor income  $V$  has an a priori expected positive sign.

### c) Results

To discuss our estimation of arts and non arts hours equations, we start by presenting the results of the first stage probit model for non arts labor market participation, shown in table 4.

Table 4				
Probit estimates				
Participation in non arts labor market				
Number of obs	372	Pseudo R2	0.12	
Wald chi2(5)	42.260	Log likelihood	-227.39	
Prob > chi2	0.000			
	Coef.	Robust Std. Err.	Z	P> z
Household head	0.513	0.186	2.760	0.006
Experience in arts	-0.013	0.006	-2.230	0.026
Children	0.307	0.150	2.040	0.041
Months employed in arts	-0.082	0.024	-3.410	0.001
Wage worker in arts	-1.145	0.242	-4.730	0.000
Self employed in arts	-0.412	0.149	-2.770	0.006
Constant	0.683	0.260	2.620	0.009

Using the probit estimates we calculate the sample selection term to be included in the corrected estimates (following Heckman, 1979) non arts hours equation for part time artists. Results are displayed in table 5.

Table 5				
Heckman selection model -- two-step estimates				
(regression model with sample selection)				
Non arts hours equation, part time artists				
Dependent variable is ln of non arts hours				
Number of obs	376			
Censored obs	200			
Uncensored obs	176			
Wald chi2(4)	57.94			
Prob > chi2	0.00			
	Coef.	Std. Err	z	P> z
Log non arts wage	-0.159	0.044	-3.610	0.000
Log non labor income	-0.027	0.014	-1.990	0.047
Arts experience	0.013	0.004	3.020	0.003
Children dummy	0.205	0.109	1.870	0.061
Tropical music	0.267	0.116	2.290	0.022
Afro Uruguayan music	-0.436	0.177	-2.470	0.014
Constant	5.337	0.212	25.130	0.000
Mills' lambda	-0.268	0.165	-1.620	0.105

Table 5 shows that, for part time artists, non arts wages have a statistically significant (and

negative) influence both in hours devoted to non arts work. As to the economic significance of such impact, The implied elasticity of 0,16 reflects a modest decrease in working time outside art after a wage increase. Non labor income also has a slight and negative influence in labor market time of part time artists.

In table 6 we show the (sample selection corrected) estimates of parameters in arts hours equation for part time artists.

Table 6 Heckman selection model -- two-step estimates (regression model with sample selection) Arts hours equation, part time artists Dependent variable is ln of arts hours				
Number of obs		376		
Censored obs		200		
Uncensored obs		176		
Wald chi2(4)		27.2		
Prob > chi2		0.001		
	Coef.	Std. Err	z	P> z
Log non arts wage	-0.172	0.069	-2.490	0.013
Log non labor income	0.017	0.021	0.800	0.421
Arts experience	-0.004	0.007	-0.560	0.576
Children dummy	-0.058	0.175	-0.330	0.740
Tropical music	0.129	0.183	0.710	0.479
Afro Uruguayan music	0.151	0.278	0.540	0.588
Constant	4.520	0.336	13.440	0.000
Mills' lambda	0.553	0.263	2.100	0.036

We do find a very similar in magnitude negative impact of the wage in arts time, while in this case non labor income does not exert a significant impact. We also find that variables affecting arts earning potential tend to perform generally poorly in part time artists' hours equations.

Finally we undertake the estimation of the arts hours equation for full time artists. Results are shown in table 7.

Table 7 Heckman selection model -- two-step estimates (regression model with sample selection) Arts hours equation, full time artists Dependent variable is ln of arts hours				
Number of obs		377		
Censored obs		181		
Uncensored obs		196		
Wald chi2(4)		64.48		
Prob > chi2		0.00		
	Coef.	Std. Err	z	P> z
Log non labor income	0.030	0.017	1.770	0.076
Arts experience	-0.017	0.005	-3.310	0.001
Household head dummy	0.349	0.158	2.210	0.027
Children dummy	0.162	0.131	1.240	0.216
Singer dummy	-0.315	0.141	-2.230	0.026
Tango dummy	-0.690	0.208	-3.320	0.001
Afro Uruguayan music dummy	-0.530	0.230	-2.300	0.021
_cons	5.473	0.181	30.320	0.000
Mills' lambda	-0.585	0.212	-2.760	0.006

The main result that we want to stress here is that, as predicted by the model, we do find an effect of non labor income in arts work time, and in this case is positive.

## 7) Conclusions

We have developed a model that allows analyzing relevant issues in artist's time allocation, particularly the responsiveness of their arts time to economic incentives. We applied such model to the analysis of a small sample of musicians to obtain empirical results to be contrasted with our model and with some results of previous literature.

Our model provides a utility maximization framework to analyze artist time allocation. It incorporates some realistic features such as the presence of arts time in the utility function and a nonlinear relation between arts earnings and arts hours, as well as specifically allowing for an explicit role of leisure in artist's decisions.

Differently from Throsby (1994), our model leaves undetermined a priori the effect of non arts wages in arts and non arts time allocation. This issue relates more to the relevance of the outside opportunities provided by non arts labor markets to artists than to arts public



policy, since the latter rely basically in changing economic incentives to the dedication of artists by means of subsidies.

Our results show that non arts wages have a statistically significant negative effect in non arts time, of a modest economic size. In turn, they do not seem to influence time allocation decisions to arts work.

If we intended to contrast these results with Throsby (1992) we should point that some methodological differences make difficult such comparison. In Throsby's data censoring of the observed dependent variables is not accounted for, and large mass points are observed at zero non art work hours for full time artists hence biasing estimated coefficients. Leisure is not included in the time constraint; hence arts time changes are transformed at a rate  $-1$  in non arts time changes (though each time is measured as a proportion of total time). Wages are postulated in the arts sector, and obtained dividing arts earnings by hours dedicated to arts (arts hourly earnings). The paper by Rengers and Madden (2000) has a similar approach.

For part time artists, the evidence presented could be put in a perspective of simple backward bending labor supply curves in the non arts labor market, basically not different from those observed regularly for male workers (and our artists are largely male). Improvements of the state of the non arts labor market would induce them to work less outside art. This however would not translate in an increased dedication to arts work. Hence our results do not support some often cited intuition by which arts production displays a countercyclical behavior and critical times are accompanied by flourishing of artistic output and creation. If in times of crisis more artistic output is observed it may respond to exacerbated sensitivity but not to the change in the set of opportunities and then in time allocation.

Different effects of non labor income were found between part time and full time artists. This can be potentially relevant to evaluate the role of subsidies in effectively changing dedication to arts activity. While for part time artists non labor income increases reduce hours in the labor market, they are irrelevant in generating longer hours in art. Conversely in the case of full time artists, according with the predictions of our model, non labor income does increase arts time dedication.

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## Appendix

### Proof of Proposition 1

a. This follows from the strict inequality in equations (12) and (13) for the full time artist.

$$\frac{U_l}{U_c} > w$$

$$\frac{U_{h_A} + f_l U_c}{U_c} > w$$

The only one affected would be someone for which the constraint  $h_A \geq 0$  is binding exactly at the margin, which for any continuous distribution of individuals across  $w$  has zero probability.

b. Both  $w$  and  $\theta$  affect (7) and (8). ■

### Proof of Proposition 2

The reservation wage would be the wage  $w_R$  at which the individual chooses to work exactly 0 non arts hours. We add the condition  $l = T - h_A$ , and obtain  $c = f(h_A, \theta) + V$ . The reservation wage is obtained substituting in equation (7') from part time artist's first order conditions:

$$\frac{x_2 (f(h_A, \theta) + V)^{1-\rho}}{x_1 (T - h_A)^{1-\rho}} - w_R = 0$$

It is immediate that  $w_R$  depends positively on market attractiveness  $\theta$  and unearned income  $V$ . ■

For propositions 3 to 6, by assumption (2),  $U(c, l, h_A) = (x_1 c^\rho + x_2 l^\rho + x_3 h_A^\rho)^{\frac{1}{\rho}}$ . Constrained utility maximization in the case of a part time artist, working with the first order conditions (equations (7'), (8') and (9')), gives the following system of equations:

$$\frac{x_2 c^{1-\rho}}{x_1 l^{1-\rho}} - w = 0 \tag{7'}$$

$$\frac{x_3 c^{1-\rho}}{x_1 h_A^{1-\rho}} - (w - f_1) = 0 \tag{8'}$$

$$c - wT + wl + wh_A - f(h_A, \theta) - V = 0 \tag{9'}$$

Taking the total differential of equations (7'), (8') and (9') we get:

$$\frac{x_2(1-\rho)c^{-\rho}}{x_1l^{1-\rho}}dc - \frac{x_2(1-\rho)c^{1-\rho}}{x_1l^{2-\rho}}dl - dw = 0 \quad (14)$$

$$\frac{x_3(1-\rho)c^{-\rho}}{x_1h_A^{1-\rho}}dc + \left( f_{11} - \frac{x_3(1-\rho)c^{1-\rho}}{x_1h_A^{2-\rho}} \right)dh_A - dw + f_{12}d\theta = 0 \quad (15)$$

$$dc + wdl + (w - f_1)dh_A - (T - l - h_A)dw - f_2d\theta - dV = 0 \quad (16)$$

Writing in matrix form:

$$\begin{pmatrix} \frac{x_2(1-\rho)c^{-\rho}}{x_1l^{1-\rho}} & -\frac{x_2(1-\rho)c^{1-\rho}}{x_1l^{2-\rho}} & 0 \\ \frac{x_3(1-\rho)c^{-\rho}}{x_1h_A^{1-\rho}} & 0 & \left( f_{11} - \frac{x_3(1-\rho)c^{1-\rho}}{x_1h_A^{2-\rho}} \right) \\ 1 & w & w - f_1 \end{pmatrix} \begin{pmatrix} dc \\ dl \\ dh_A \end{pmatrix} = \begin{pmatrix} dw \\ dw + f_{12}d\theta \\ (T - l - h_A)dw + f_2d\theta + dV \end{pmatrix} \quad (17)$$

To simplify notation we define

$$A = \begin{pmatrix} a & -b & 0 \\ c & 0 & -d \\ 1 & w & w - f_1 \end{pmatrix} = \begin{pmatrix} \frac{x_2(1-\rho)c^{-\rho}}{x_1l^{1-\rho}} & -\frac{x_2(\rho-1)c^{1-\rho}}{x_1l^{2-\rho}} & 0 \\ \frac{x_3(1-\rho)c^{-\rho}}{x_1h_A^{1-\rho}} & 0 & \left( f_{11} - \frac{x_3(\rho-1)c^{1-\rho}}{x_1h_A^{2-\rho}} \right) \\ 1 & w & w - f_1 \end{pmatrix} \quad (18)$$

Where  $a$ ,  $b$ ,  $c$  and  $d$  are respectively

$$a = \frac{x_2(1-\rho)c^{-\rho}}{x_1l^{1-\rho}} = \frac{(1-\rho)U_C}{c U_l} > 0;$$

$$b = \frac{x_2(\rho-1)c^{1-\rho}}{x_1l^{2-\rho}} = \frac{(1-\rho)U_C}{l U_l} > 0;$$

$$c = \frac{x_3(1-\rho)c^{-\rho}}{x_1h_A^{1-\rho}} = \frac{(1-\rho)U_C}{c U_{h_A}} > 0;$$

$$d = -\left( f_{11} - \frac{x_3(\rho-1)c^{1-\rho}}{x_1h_A^{2-\rho}} \right) = \frac{(1-\rho)U_C}{h_A U_{h_A}} - f_{11} > 0$$

and rewrite the system of equations in (17) as

$$A \begin{pmatrix} dc \\ dl \\ dh_A \end{pmatrix} = \begin{pmatrix} dw \\ dw + f_{12}d\theta \\ (T-l-h_A)dw + f_2d\theta + dV \end{pmatrix}$$

**Lemma 1.** The determinant of matrix A is positive:

Proof:  $|A| = bd + bc(w - f_1) + adw > 0$  ■

**Proof of Proposition 3**

Setting  $dw = d\theta = 0$  and dividing by  $dV$ , the system (5) becomes:

$$\begin{pmatrix} a & -b & 0 \\ c & 0 & -d \\ 1 & w & w-f_1 \end{pmatrix} \begin{pmatrix} dc/dV \\ dl/dV \\ dh_A/dV \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix}$$

Applying Cramer’s rule we get the following signs:

a.  $\frac{dl}{dV} = \frac{1}{|A|} \begin{vmatrix} a & 0 & 0 \\ c & 0 & -d \\ 1 & 1 & w-f_1 \end{vmatrix} = \frac{1}{|A|} ad > 0$       b.  $\frac{dh_A}{dV} = \frac{1}{|A|} \begin{vmatrix} a & -b & 0 \\ c & 0 & 0 \\ 1 & w & 1 \end{vmatrix} = \frac{1}{|A|} bc > 0$

The derivatives of both leisure and arts time with respect to non labor income are positive. Arts time and leisure are (given our utility function choice) normal goods; hence the income effect is in both cases positive.

b.  $h_N = T - l - h_A$ , therefore

$$\frac{dh_N}{dV} = -\frac{dl}{dV} - \frac{dh_A}{dV} = -\frac{1}{|A|}(ad + bc) < 0$$

This can be interpreted as a pure income effect in labor market hours. A richer individual would unequivocally work less in the labor market. It results directly from b. and c. ■

**Proof of Proposition 4**

Setting  $dV = d\theta = 0$  and dividing by  $dw$ , the system (17) becomes:

$$\begin{pmatrix} a & -b & 0 \\ c & 0 & -d \\ 1 & w & w-f_1 \end{pmatrix} \begin{pmatrix} dc/dw \\ dl/dw \\ dh_A/dw \end{pmatrix} = \begin{pmatrix} 1 \\ 1 \\ T-l-h_A \end{pmatrix}$$

Applying Cramer's rule we get the following signs:

$$\text{a. } \frac{dl}{dw} = \frac{1}{|A|} \begin{vmatrix} a & 1 & 0 \\ c & 1 & -d \\ 1 & T-l-h_A & w-f_1 \end{vmatrix} = \frac{1}{|A|} [(a-c)(w-f_1) - d + ad(T-l-h_A)], \text{ cannot be signed.}$$

In this case  $\frac{dl}{dw} = \frac{1}{|A|} [(a-c)(w-f_1) - d] + \frac{dl}{dV} (T-l-h_A)$ . The second term in the right hand side is again the income effect, which we know is positive. The first term in the right hand side is the substitution effect, reflecting the existence of two margins to optimize. The sign depends on the sign of the difference  $(a-c)$  which depends on the difference in slopes of marginal rates of substitution between consumption and leisure and between consumption and arts time. If this difference is negative then the whole substitution effect is negative, and the net effect still depends on the size of both effects. If the difference  $(a-c)$  is positive, then the substitution effect is positive and so it is the net effect.

$$\text{b. } \frac{dh_A}{dw} = \frac{1}{|A|} \begin{vmatrix} a & -b & 1 \\ c & 0 & 1 \\ 1 & w & T-l-h_A \end{vmatrix} = \frac{1}{|A|} [(c-a)w - b + bc(T-l-h_A)], \text{ cannot be signed.}$$

This case is symmetric to case a. We have

$$\frac{dh_A}{dw} = \frac{1}{|A|} [(c-a)w - b] + \frac{dh_A}{dV} (T-l-h_A),$$

in which the second term in the right hand side is the positive income effect. To have the first term on the right hand side positive, we need  $(c-a)w - b > 0$ .

c.  $h_N = T-l-h_A$ , therefore

$$\frac{dh_N}{dw} = -\frac{dl}{dw} - \frac{dh_A}{dw} = -\frac{1}{|A|} [(a-c)f_1 + b + d - (ad + bc)(T-l-h_A)], \text{ cannot be signed.}$$

Here we have  $\frac{dh_N}{dw} = \frac{1}{|A|} [(a-c)f_1 + b + d] - \left( \frac{dl}{dV} + \frac{dh_A}{dV} \right) (T - l - h_A)$

The income effect is always negative, and we cannot sign the substitution effect. ■

### Proof of Proposition 5

Setting  $dV = dw = 0$  and dividing by  $d\theta$ , the system (17) becomes:

$$\begin{pmatrix} a & -b & 0 \\ c & 0 & -d \\ 1 & w & w-f_1 \end{pmatrix} \begin{pmatrix} \frac{dc}{d\theta} \\ \frac{dl}{d\theta} \\ \frac{dh_A}{d\theta} \end{pmatrix} = \begin{pmatrix} 0 \\ -f_{12} \\ f_2 \end{pmatrix}$$

Applying Cramer's rule we get the following signs:

a.  $\frac{dl}{d\theta} = \frac{1}{|A|} \begin{vmatrix} a & 0 & 0 \\ c & -f_{12} & -d \\ 1 & f_2 & w-f_1 \end{vmatrix} = \frac{a}{|A|} [-f_{12}(w-f_1) + df_2]$  cannot be signed.

b.  $\frac{dh_A}{d\theta} = \frac{1}{|A|} \begin{vmatrix} a & -b & 0 \\ c & 0 & -f_{12} \\ 1 & w & f_2 \end{vmatrix} = \frac{1}{|A|} [bf_{12} + bcf_2 + awf_{12}] > 0$

c.  $h_w = T - l - h_A$ , therefore

$$\frac{dh_w}{d\theta} = -\frac{dl}{d\theta} - \frac{dh_A}{d\theta} = -\frac{1}{|A|} [-af_{12}(w-f_1) + adf_2 + bf_{12} + bcf_2 + awf_{12}]$$

$$\frac{dh_w}{d\theta} = -\frac{1}{|A|} [af_{12}f_1 + adf_2 + bf_{12} + bcf_2] < 0$$

### Proof of Proposition 6

a.  $\frac{dl}{d\theta} = \frac{1}{|A|} \begin{vmatrix} a & 0 & 0 \\ c & -f_{12} & -d \\ 1 & f_2 & w-f_1 \end{vmatrix} = \frac{a}{|A|} [df_2 - f_{12}(w-f_1)]$



Substituting from equation (8') and the definition of  $d$  we obtain:

$$\frac{dl}{d\theta} = \frac{a}{|A|} \left[ - \left( f_{11} - \frac{x_3(1-\rho)c^{1-\rho}}{x_1 h_A^{2-\rho}} \right) f_2 - f_{12} \frac{x_3 c^{1-\rho}}{x_1 h_A^{1-\rho}} \right] = \frac{a}{|A|} \left[ - f_{11} f_2 + \frac{x_3 c^{1-\rho}}{x_1 h_A^{2-\rho}} (-f_{12} h_A + f_2(1-\rho)) \right]$$

Therefore, assumption 4 is a sufficient condition for  $\frac{dl}{d\theta} > 0$ . ■

### Proof of proposition 7

For a full time artist,  $T = l + h_A$ . The individual's problem is now:

$$\text{Max}_{c, h_A} U(c, h_A) = \left( x_1 c^\rho + x_2 (T - h_A)^\rho + x_3 h_A^\rho \right)^{\frac{1}{\rho}}$$

$$\text{subject to } c - f(h_A, \theta) - V = 0$$

First order conditions are in this case:

$$\frac{x_3 c^{1-\rho}}{h_A^{1-\rho}} - \frac{x_2 c^{1-\rho}}{(T - h_A)^{1-\rho}} - f_1 = 0$$

$$c - f(h_A, \theta) - V = 0$$

Taking the total differential of both equations we get:

$$\left( \frac{x_3}{h_A^{1-\rho}} - \frac{x_2}{(T - h_A)^{1-\rho}} \right) (1-\rho) c^{-\rho} dc + \left\{ (1-\rho) c^{1-\rho} \left( \frac{x_3 h_A^{-\rho}}{h_A^{2-2\rho}} + \frac{x_2 (T - h_A)^{-\rho}}{(T - h_A)^{2-2\rho}} \right) - f_{11} \right\} dh_A - f_{12} d\theta = 0$$

$$dc - f_1 dh_A - f_2 d\theta - dV = 0$$

Writing in matrix form:

$$\begin{pmatrix} \left( \frac{x_3}{h_A^{1-\rho}} - \frac{x_2}{(T - h_A)^{1-\rho}} \right) (1-\rho) c^{-\rho} & (1-\rho) c^{1-\rho} \left( \frac{x_3}{h_A^{2-2\rho}} + \frac{x_2}{(T - h_A)^{2-2\rho}} \right) - f_{11} \\ 1 & -f_1 \end{pmatrix} \begin{pmatrix} dc \\ dh_A \end{pmatrix} = \begin{pmatrix} f_{12} d\theta \\ f_2 d\theta + dV \end{pmatrix}$$

To simplify notation we define

$$A = \begin{pmatrix} a & b \\ 1 & c \end{pmatrix} = \begin{pmatrix} \left( \frac{x_3}{h_A^{1-\rho}} - \frac{x_2}{(T-h_A)^{1-\rho}} \right) (1-\rho)c^{-\rho} & (1-\rho)c^{1-\rho} \left( \frac{x_3}{h_A^{2-\rho}} + \frac{x_2}{(T-h_A)^{2-\rho}} \right) - f_{11} \\ 1 & -f_1 \end{pmatrix}$$

Where  $a$ ,  $b$  and  $c$  are respectively

$$a = \left( \frac{x_3}{h_A^{1-\rho}} - \frac{x_2}{(T-h_A)^{1-\rho}} \right) (1-\rho)c^{-\rho}; \quad b = (1-\rho)c^{1-\rho} \left( \frac{x_3}{h_A^{2-\rho}} + \frac{x_2}{(T-h_A)^{2-\rho}} \right) - f_{11};$$

$$c = -f_1 < 0$$

The sign of  $a$  is the sign of  $\left( \frac{x_3}{h_A^{1-\rho}} - \frac{x_2}{(T-h_A)^{1-\rho}} \right)$ ; from first order conditions we obtain that

$$U_{h_A} = U_C f_1 > 0. \text{ As } U_{h_A} = U^{1-\rho} \left( \frac{x_3}{h_A^{1-\rho}} - \frac{x_2}{(T-h_A)^{1-\rho}} \right), \text{ it must be } \left( \frac{x_3}{h_A^{1-\rho}} - \frac{x_2}{(T-h_A)^{1-\rho}} \right) > 0.$$

Hence  $a > 0$ .

As the sign of  $-f_{11}$  is unequivocally positive, the sign of  $b$  depends on the sign of

$$\left( \frac{x_3}{h_A^{2-\rho}} + \frac{x_2}{(T-h_A)^{2-\rho}} \right), \text{ hence } b > 0$$

The system of equations in (17) can be rewritten as

$$A \begin{pmatrix} dc \\ dh_A \end{pmatrix} = \begin{pmatrix} f_{12} d\theta \\ f_2 d\theta + dV \end{pmatrix}$$

The determinant of the matrix  $A$  is given by  $|A| = ac - b$ ; then  $|A| < 0$ .

Setting  $d\theta = 0$  and dividing by  $dV$ , the system (5) becomes:

$$\begin{pmatrix} a & b \\ 1 & c \end{pmatrix} \begin{pmatrix} dc/dV \\ dh_A/dV \end{pmatrix} = \begin{pmatrix} 0 \\ 1 \end{pmatrix}$$

Applying Cramer's rule we get  $\frac{dh_A}{dV} = \frac{1}{|A|} \begin{vmatrix} a & 0 \\ 1 & 1 \end{vmatrix} = \frac{a}{|A|} > 0$

Setting  $dV = 0$  and dividing by  $d\theta$ , the system (5) becomes:

$$\begin{pmatrix} a & b \\ 1 & c \end{pmatrix} \begin{pmatrix} dc/d\theta \\ dh_A/d\theta \end{pmatrix} = \begin{pmatrix} f_{12} \\ f_2 \end{pmatrix}$$

Applying Cramer's rule we get  $\frac{dh_A}{d\theta} = \frac{1}{|A|} \begin{vmatrix} a & f_{12} \\ 1 & f_2 \end{vmatrix} = \frac{1}{|A|} (af_{12} - f_2) > 0$ .

