The Riddle of the Sands?
Intertemporal Substitution of Labour for Archaeological Workers in Northern Syria in 1938.

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Abstract.

This paper analyzes the daily participation decisions of Syrian archaeological workers in 1938. Our unique data affords us the opportunity to study the sign and size of the intertemporal labour supply elasticity as the daily wage workers received had a stochastic element which consisted of payments for finds that the worker made on each day of the dig. The value of these finds we argue represented transitory movements in the worker's wage which can be used to identify the intertemporal elasticity.

JEL classification: J22, J30, J40.

Keywords: Intertemporal labour supply, Bakshish.

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I. Introduction.

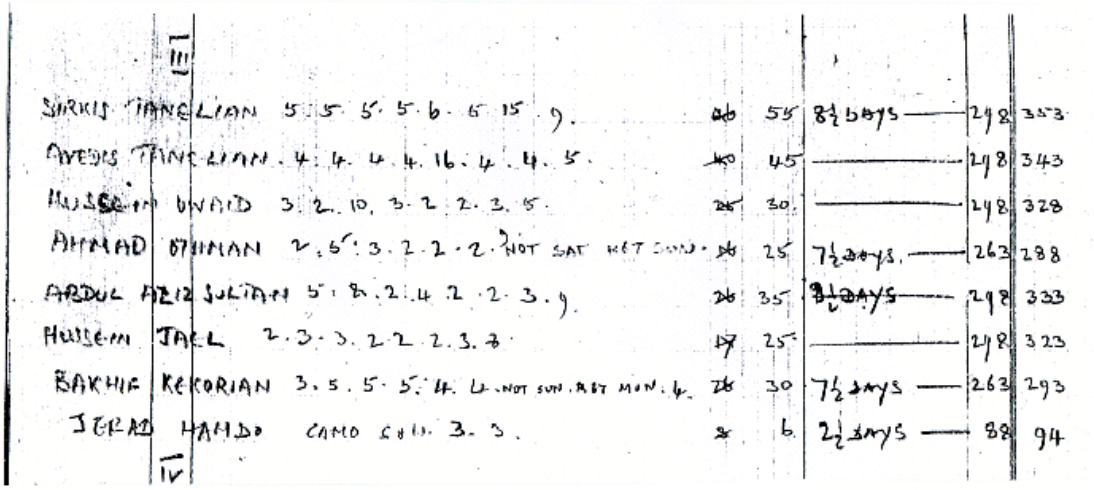
This paper analyzes the daily labour supply or absence decisions of workers employed on an archaeological dig in North East Syria in 1938. We argue that this particular labour market is an attractive one to study if the sign (and size) of the inter-temporal labour supply elasticity is of interest. In broad terms workers will respond to wage changes by increasing their labour supply if this response can be seen solely as a substitution effect. This can be achieved if the wage change is sufficiently well anticipated that the worker builds the change into his or her permanent income, so the wage change when it is observed does not entail any (permanent) income shift. This can also be achieved when the wage shift is purely transitory, in which case there will be negligible effects on income. Our data affords us the opportunity to study this elasticity as our daily wage data has a stochastic element which consists of payments (which were called bakshish) for finds that the worker makes on each day of the dig. This unforeseen element in remuneration we argue allows us to identify the effect of transitory wage shocks on labour supply. We also argue that there won't be significant countervailing aggregate supply effects, in the sense of extra workers entering the market as potential remuneration increases. As far as we are able to establish the archaeologist directing the dig took on a pool of workers at the start of the dig and didn't make significant additions subsequently, indeed it appears that the number of worker employed fell.

We will focus on the labour supply of these workers at the extensive margin , that is whether they chose to participate on a given day. In this sense our paper is similar to studies of the labour supply of food vendors at baseball games by Oettinger (1999). We have little direct data on worker effort in this inter-temporal context, the interested reader should consult Treble(2003) on this point. However we have in mind that that the archaeological workers are faced with a routine task of digging in a systematic and careful fashion for items. He has no particular reason to think that digging extra fast with involve more finds - and hence higher wages – since he has no idea whether he will find some objects or not. In this situation he will work at a steady pace and take whatever comes along. Anecdotal evidence support the view that archaeological workers are actually encouraged to work in this way, because if they work 'too fast' they may miss some small object. From the standpoint of our

economic model this is a very convenient feature of the situation as it means that the worker is not making decisions on any effort margin, he is simply deciding whether to supply his labour on a given day – conditional on their past bakshish payments.

The study is facilitated by the careful record keeping of the eminent archaeologist Max Mallowan (MM) and the fortunate survival of his pay book recording daily wage payments to his site workers in his excavation of the archaeological site at Tell Brak in Syria in 1938. Over a period of nearly two months during this dig MM in that year kept incredibly detailed handwritten records, of the daily labour supplied by each worker and the resulting wage payments made to each worker. A small section of this pay book has been scanned and appears in Figure 1 below.

Figure 1: Section of Max Mallowan's Wage Book from Tell Brak 1938.



reading along the first line this worker received a total payment of 353 mejidi (the local currency) for his weeks work, 55 in bakshish and 298 basic pay.

II. The Literature on Intertemporal Labour Supply.

The literature on the intertemporal labour supply elasticity as it stands doesn't give a clear message on the estimated value of inter-temporal elasticity. Early estimates of life cycle models which used panel data – for example Altonji (1986) -

suggested that this elasticity is really very small. However many early studies in this literature used annual changes in hours worked in response to annual wage changes, and as has been suggested by some researchers in the area that it seems doubtful that the measured annual wage changes is either fully anticipated or purely transitory. To try and overcome these problems some subsequent studies have tried to exploit specific aspects of certain labour markets to identify the effects, and this study is in this vein.

Camerer et al (1997) studied the daily labour supply decisions of New York City cab drivers. They argued that the demand for taxi services is subject to large transitory shocks due to the weather. They use this 'exogenous' shift in demand to estimate a negatively significant wage elasticity. In other words they claimed that cab drivers hare very short time horizons and will be more like to quit work when they receive an sudden, unanticipated increase in daily income.

Oettinger (1999) also analyzes the daily labour supply behaviour of food and beverage vendors at a single stadium over an entire baseball season. Quite rightly Oettinger suggests that the wage data he observes will be endogenously determined. He uses observable shifts in product demand (as measured by attendance at the game and other characteristics of the match) to instrument for the vendor wage. He finds positive elasticity estimates of between .55 and .65. Hence he suggests that a stadium vendor is much more likely to supply his labour at the next game if he or she anticipates a higher wage. Oettinger argues that wage determination in these situations is clearly endogenous (this is his main criticism of the Camerer paper) as both demand conditions and vendor labour supply decisions will determine the observed wage. Oettinger takes account of this in his estimation.

The model of intertemporal labour supply can be tested in a situation in which individuals receive truly random transitory shocks to their earnings, if the shock is purely transitory and relatively small then there will be no significant income effect, this is essentially the aspect of the market for cab rides that Camerer et al were trying to exploit. We would also like to observe such data over a considerable time for a large enough group of workers to facilitate practical estimation. Finally we would like to be able to find data in which the actions of the agent supplying the labour are

independent of the market forces of labour supply and demand. We think we have found such data in our sample of archaeological workers since our bakshish payments are random components which depend on finds on a daily basis and they do not impact on the daily base wage. Hence we do not need to seek the 'demand shifter variables' that Oettinger (1999) advocates are necessary for identification.

The bakshish payments follow a particular stochastic structure. An *initial* "good" find (above the average in terms of value) is unanticipated, thereafter the *expected* value of subsequent finds follows and autocorrelated structure the nature of which is well understood by the workers. So the worker anticipates a higher expected value of his finds at day t+1 if he had a higher than average find at day t.

In what we do we will in fact use only the bakshish payments for our analysis and ignore the base wage which is completely determined by the daily rate. In addition we will find it more convenient to model the absence decision rather than the labour supply decision since we have no variation in hours worked within the day as all workers either worked the whole day or not at all.

III. Background Information on the Labour Market for Archaeological Workers.

MM was from the traditional school of archaeology. He was trained by the eminent archaeologist Lord Leonard Woolley who was the Keeper of the Ashmolean Museum. '*he dug systematically to ensure comparison with finds at complementary sites both geographically and chronologically*.' McCall (2001b), p53.

The pattern of aggregate bakshish payments is reported in Figure 2 As one might expect that the finds would be modest at the start of a dig until a specific depth was reached. However the level of payments seems to have been relatively constant for the first three-quarters of the dig. There is evidence that MM was adjusting the prices (upwards) for finds in the early days of the dig, we interpret this as him trying to set prices at the point at which workers would chose to sell the find to him rather than try and smuggle finds off site, which would run the risk of sacking. Later on MM

made less such adjustments, we presume that he judged he had found the correct level.

Figure 2: Aggregate Bakshish Payments at Tell Brak

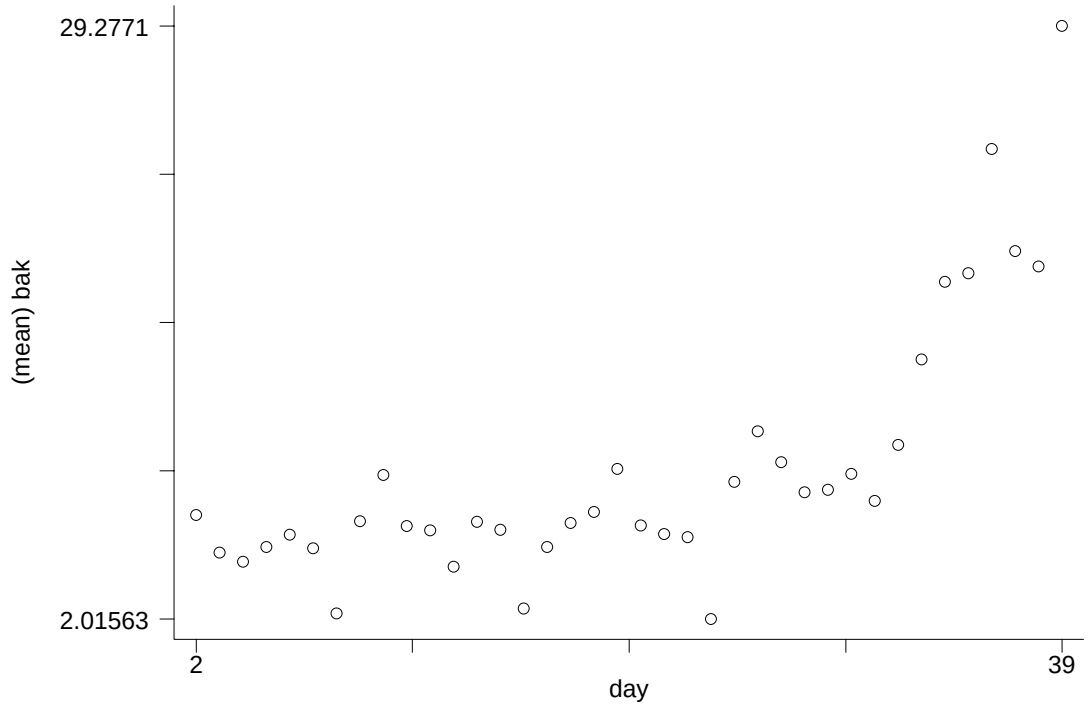
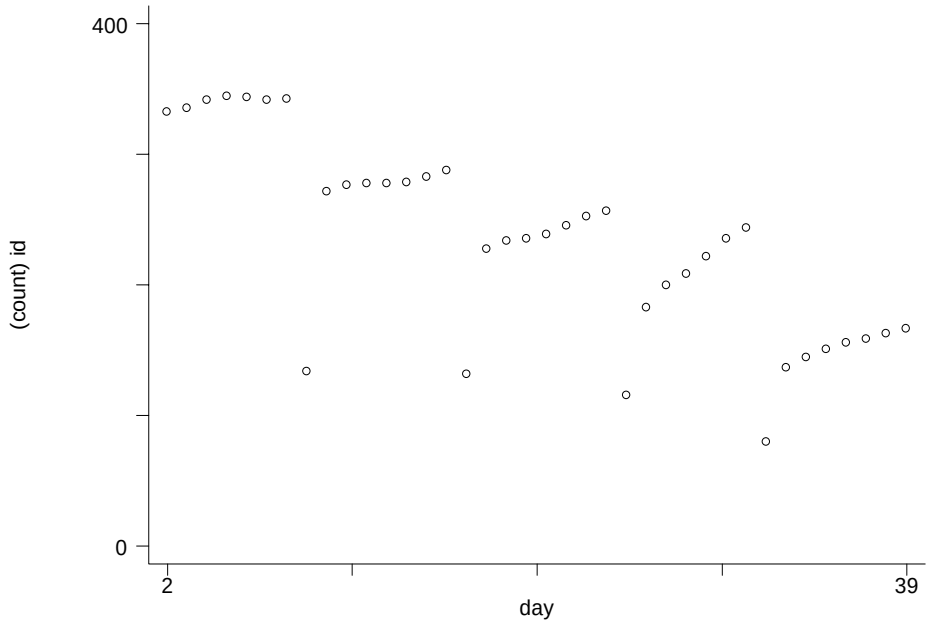


Figure 3 Number of workers



The pattern of daily labour supply over the course of the dig is graphed in Figure 3 in terms of the number of workers who work on any given day in the dig. The five 'weeks' of the dig are clearly distinguishable as there is a clear cycle to each week. Within each week labour supply starts off low (or absence is high) at the beginning of the week and builds slowly during the week until attendance is highest on the last day of each week – which is payday. Over the life time of the dig, from week I to week V the number of workers employed slowly falls as the work involved in the dig slowly exhausts itself. In wage book itself there are a few number of workers employed for a prior week (which was in fact in 1937, almost a year before the main dig in which it appears the site was marked out ready for the main work)

We argue that the demand for labour (per day) by MM is fixed and constant and the labour supply decision is an individual one. Naturally, in reality, there is a fair degree of unobserved heterogeneity involved in the nature of supply and demand. On the demand side it may be the case that: unexpectedly large finds require extra workers, dangerous digging conditions necessitate extra workers to solve a problem at short notice, the unforeseen absence or sickness of some workers dictates that additional workers are required at short notice, agricultural crop harvests mean workers return to their villages, or weather conditions change in an unforeseen way and this delays or prevents work and this has knock on effects. On the supply side the individual may be unable or unwilling to supply their labour on a given day for a variety of reasons associated with family or village obligations and other personal factors. However MM doesn't seem to have imposed any extra penalties on workers who absent themselves on particular days and then return.

What is the financial nature of an archaeological expedition ? MM would typically 'cobble together' funds for his expeditions from a number of sources. The precise sources of funds are not detailed for the expedition to Brak are not recorded. However the account in McCall (2001a) may be typical of how an expedition was funded. 'He spoke to the Director of the British Museum, … who consulted with his Trustees. They were happy to sponsor him, but only in a small way. He had more luck with Sir Edgar Bonham Carter, the Chairman of the British School of Archaeology in Iraq, which put up £600. ….The Percy Sladen Memorial Fund made

a grant of £400 towards the funds required for excavating Tell Arpachiyah. ' McCall (2001), p.84. The total funds now then stood £1100 and MM thought it would be 'less difficult to find the remainder'. MM then wrote a brochure describing the nature of his proposed expedition and its importance to prospective backers. It brought in the rest of the funding. We are also told that Agatha was often a backer for MM. Agatha '…also supported the excavations as an anonymous sponsor….. Sometimes she donated the rights of a detective story to the excavations'. p.13, Trümpler (2001c)

This illustrates that the funding for expeditions was hard to come by, usually put together from a variety of sources, planned well before hand within a strict budget often scrutinized long before the expedition took place, and subject to a specific overall budget constraint.

III. A Model of Labor Supply and Bakshish Payments.

The characteristics of the bakshish payments are that they were payments based on finds made each day. On every consecutive day the finds were recorded in the pay book and each man would then receive his extra bakshish pay along with his regular pay at the end of the week. This is clearly described in several passages:

'*The bakshish payable to each man was recorded in a little book held by Michel, and at the end of each week the man's wages plus his accumulated tips were paid over . For example a cylinder seal – he made sure the finder was properly rewarded. On the other hand, he occasionally awarded small sums for worthless items as a means of encouragement'*. p.109 , McCall (2001a)

'To encourage the workman to keep a sharp eye open and dig with great care, Max paid bakshish for every good find. They were intrigued by the difficulty of predicting how he would assess an object. The little boys whose job it was to look through the contents of the baskets of soil a second time in search of finds could earn as much money in this way as a grown spademan or a pickman. Every afternoon, just before work ended, the workmen lined up to show Max any special finds. If these items found favour with him, he would write down the sum earned beside each name in a book,

and when pay-day came the bakshish was paid out along with the regular working wage. Every worker remembered exactly what he was owed and would put the record straight if he was paid too little or even too much.' ' p.188-9, Trümpler (2001b)

There seems to have been little scope for cheating this bakshish system either by digging where one was not assigned to or by trying to sell finds outside. Digging outside limits was monitored:

'The dig in Tell Brak was extremely successful, producing a quantity of objects of very high quality. In the last season of digging, during the autumn of 1938, however, there was a serious incident that clearly illustrates the potential dangers of such excavations and at the same time gives a glimpse of the mentality of the local people.

Many finds of beautiful animal amulets in stone or ivory had earned the workers plenty of bakshish. Since bakshish represented good additional earnings, the idea of the money undoubtedly induced some of the men to try their hand at forgery now and then. On the dig in Tell Brak, however, the animal amulets led to something much worse. They were found at a certain depth in a shaft that was supposed to be cut straight down from the top. However to get at the area containing the amulets as quickly as possible the men started undercutting at the bottom of the shaft, without permission and indeed against Max's express orders. During a midday break some of them crept into the shaft from the far side of the mound. And went on with the undercutting, planning to say that the figures were finds from their own part of the site and earn bakshish for them. But the overhang broke away, burying five men, and only one of them was brought out alive. After the matter had been settled with the sheikh and the French security officer, Max posted a guard at the scene of the accident, fearing further illicit digging. He himself waited out of sight during the next day's midday break, and caught three more workmen in the act of coming to dig at the same spot. The rest of the men showed little respect for the dead, making fun of them in song and gestures. The members of the archaeological team had already noted on other occasions that death counted for very little in these countries.' p.202-3, Trümpler (2001b)

We also know from sources that there was a fair degree of monitoring of what the workers were doing. Agatha herself spent a lot of time observing the workers and

acted like a spy – reporting workers who were hiding or asleep and taking photos !. Hence we do not think it would have been easy for any worker to smuggle out of the site any find to try and sell it on the black market. Also we do not know if such a black market in these objects would have existed.

We argue that these Bakshish payments represent transitory and unanticipated wage shocks to workers at an individual level and as such should induce a positive labour supply response, see Altonji (1988), Camerer *et al* (1997), Oettinger (1999) amongst others

IV An Economic Model

We will assume that on each day the worker has the choice between attending work or absenting himself. Each of these actions will have a utility payoff,

$$\begin{aligned} U_t^A &= b(T) + \varepsilon_t^A \\ U_t^W &= a(x_t) + b(T-h) + \varepsilon_t^W \end{aligned} \qquad (1)$$

a and b are concave functions with $a'(.) > 0\ b'(.) > 0$ and $a''(.) < 0\ b''(.) < 0$. T is the stock of time, h contracted hours and x_t earnings. The central element of the situation we are analysing is the stochastic structure of these earnings. We will examine this first. We know that daily earnings were made up of two components, base pay

$$x_t = x_B + k_t \qquad (2)$$

k_t is the worker's realised bakshish payment at time t. We assume that this quantity is determined in the following way.

$$\begin{aligned} t=1: &\qquad k_1 = \alpha + v_1 \\ t>1: &\qquad \begin{aligned} k_t &= \alpha + \rho(k_{t-1} - \alpha) + v_t \\ &= \alpha(1-\rho) + \rho k_{t-1} + v_t \end{aligned} \end{aligned} \qquad (3)$$

This scheme has the following property

$$\begin{aligned} E(k_1) &= \alpha \\ E(k_2) &= \alpha(1-\rho) + \rho E(k_1) = \alpha \end{aligned} \tag{4}$$

and similarly for larger values of t, however, the conditional expectation

$$E(k_2 \mid k_1) = \alpha(1-\rho) + \rho k_1 \tag{5}$$

The probability of observing the worker absence at time t can be written as

$$\begin{aligned} P_t &= P(U_t^A > U_t^W) \\ &= P(b(T) + \varepsilon_t^A > a(x_t) + b(T-h) + \varepsilon_t^W) \\ &= P(b(T) - a(x_t) - b(T-h) > \varepsilon_t^W - \varepsilon_t^A) \end{aligned} \tag{6}$$

which implies that

$$\frac{\partial P_t}{\partial k_{t-1}} = \frac{\partial P_t}{\underbrace{\partial a}_{-ve}} \underbrace{\frac{\partial a}{\partial E(x_t)}}_{+ve} \underbrace{\frac{\partial E(x_t)}{\partial k_{k-1}}}_{+ve} < 0 \tag{7}$$

the probability of absence will be negatively related to past bakshish.

V. Econometric Estimation.

The labour supply margin which we propose to use to analyse the possible intertemporal behaviour of these workers is their attendance at work. The empirical link we are examining is whether there exists a link between level of the payments the worker obtains and his individual probability of attending. The appropriate econometric structure we argue is a discrete panel data model which has been used in the analysis of absence patterns before, see Barmby, Orme and Treble (1992,1995) and Barmby (2002).

Accordingly, we model the incidence of absence of a worker from the site using a latent variable structure to generate the observed binary absence event history.

Let

$$d_{it} = \begin{cases} 1 & if\ d_{it}^{*} > 0 \\ 0 & if\ d_{it}^{*} \le 0 \end{cases} \qquad (6)$$

where

$$d_{it}^{*} = \beta k_{it-1} + \gamma d_{it-1} + \sigma u_i + v_{it}; i = 1,...,N; t = 1,...,T_i \qquad (7)$$

This structure allows us to model the probability of the event of a worker not attending on a given day

$$\begin{aligned} & P(d_{it} = 1) = P(d_{it}^{*} > 0) \\ & = P(\beta k_{it-1} + \gamma d_{it-1} + \sigma u_i + v_{it} > 0) \qquad (8) \\ & = F(\beta k_{it-1} + \gamma d_{it-1} + \sigma u_i) \end{aligned}$$

for symmetric CDF, where F is the CDF of v.

As the above indicates the probability of absence is determined for each individual by the value of the latent variable d_{it}^{*}. This is assumed to be a function of the lagged Bakshish payment k_{it-1}, and the lagged attendance indicator, d_{it-1}. The error has a components-of-variance structure, with u_i representing a time-invariant, individual-specific unobserved component, and v_{it} is the remaining error.

Assuming that u_i is a realisation of a random variable *u* with PDF $h(u)$ in the population, a marginal likelihood can be formed by integrating out u in the following way

$$\ln(\beta,\gamma) = \sum_{i=1}^{N} \ln \int_{-\infty}^{\infty} \prod_{t=2}^{T_i} [F(\beta' k_{it-1} + \gamma d_{it-1} + \sigma u)]^{d_u} [1 - F(\beta' k_{it-1} + \gamma d_{it-1} + \sigma u)]^{1-d_u} h(u) du \qquad (9)$$

where *F* is the CDF of the Logistic distribution corresponding to v_{it}. The unobserved term, *u*, is assumed to be distributed as a standard normal variate. This is the *random effects* model, the estimates of which we report shortly. An alternative empirical strategy is a *fixed effects* model

$$\ln(\beta,\gamma,\underset{\sim}{\alpha}) = \prod_{i=1}^{N}\prod_{t=2}^{T_i}[F(\alpha_i + \beta' k_{it-1} + \gamma d_{it-1})]^{d_u}[1 - F(\alpha_i + \beta' k_{it-1} + \gamma d_{it-1})]^{1-d_u} \quad (10)$$

In one sense a histogram of estimates the estimates α_i can be seen as a non-parametric estimator of the distribution of unobserved effects. Both estimations are reported here. Accounting for unobserved effects here will be important as we have some limitations on what we can observe about individual workers

We observe bakshish payments for workers on days that they work and enter the lag value in the regression component of the probability. Clearly we don't observe bakshish payments when the worker doesn't work, so there is a problem of what value to use when specifying the probability of absence when the worker was absent the previous day, in the estimates reported here we simply take the last observed bakshish payment.

Another econometric problem is whether there was any compositional effects in the gangs and if it mattered who you were working alongside. This is a problem because we are unclear how the gangs really operated. Naturally, if largely the same people work together for several weeks then ways of working and pattern of cooperation may evolve. For example, if a large find is made by one worker then a cooperative digging effort may develop as an efficient response to a large amount of digging effort being required to unearth a given object. In such a situation – if effort had been cooperative – then the resulting bakshish for the object would be shared. This is apparent in the pay book at certain points when large sums of an identical nature were paid to several workers. This kind of cooperation is likely to be higher if people have worked together before. The issue for the econometric work is how this unobserved heterogeneity can be measured? Our suggestion is that we proxy this

potential for cooperation by using the data to illuminate how often the same workers have worked together. This information is in the data as it records – on each day – all the workers who were working in each gang by name. Hence it is possible to calculate on any given day what proportion of workers the individual has worked with before in the same gang. We haven't addressed this in our estimations yet

Another issue worth considering is that we should control in our analysis for the cumulative amount of money a worker has earned up to a specific point in time. This may be important as in agrarian economies it is possible that a farmer might divert energy to earning a wage on an archaeological dig only until a specific sum of money has been made to fund the purchase of seed or some equipment or indeed to meets the food needs of his family.

VI Empirical Analysis.

Before the empirical analysis can begin we need to carefully describe the nature of the data. We have detailed records on a daily basis for each worker, on a named basis, relating to their bakshish payments. The data is organised in gangs so we know which workers are in each gang. There were to 42 gangs working in week I, but only 20 by week V. The typical size of a gang was 9 workers but in the last week one gang was only 3 workers. The largest gang was 10 workers. The composition of the gangs changed quite considerably over the course of the dig.

When a worker is absent this was carefully recorded. When a worker was sacked this was also recorded. Sacking did not seem to be a permanent state as some workers returned to work on a later date. One conceptual problem we have is distinguishing between different types of labour supply and absence. Some workers are absent for the odd day or two within the week. Others do not supply their labour for a whole week or more. Clearly there are different patterns of labour supply choices being exhibited here. Those workers who quit for a week or more may well be returning to more distant villages to tend to family or agricultural duties. Those who

are absent for a day or two within a given week are more likely to be ill, not inclined to work that day or be those workers whose home is not so far distant and may be able to return to it by absenting themselves for only a day.

There is also limited evidence in the pay book that there may be family type decisions taking place as often workers with the same family name but a different Christian name will appear in the same gang. Then in different weeks these individuals with the same surnames may absent themselves. It is possible that there is some kind of family labour supply decision with brothers of fathers and sons sharing the archaeological dig work that is available with meeting family and other agricultural commitments.

Workers work for a period 'weeks' beginning on a specific day and working for up to eight and a half days. Hence the week is not a conventional week. Then there was a rest day and following that the next 'week' would start. The structure of the weeks was as follows:

Table 1: Chronology of dig at Tell Brak 1938

Week Number	Start Date	End Date	# of Days	Start Day	End Day	Number of Gangs	Number of Workers
I	28/3/38	4/4/38	8	1	8	42	342
II	7/4/38	14/4/38	8	9	16	37	290
III	17/4/38	24/4/38	8	17	24	31	258
IV	28/4/38	3/5/38	7	25	31	29	242
V	7/5/38	14/5/38	8	32	39	20	166

We are still not certain about exactly how the week was structured. The day off was reported to be Tuesday but this is not confirmed by the pay book.
'Although it was not easy to control so many different nationalities, speaking several different languages, Max succeeded in organizing the dig without any major incidents. His diplomacy was required, for instance, to settle the delicate matter of

the day of rest. The Muslims, who outnumbered the Christians, wanted it to be Friday. The Armenians on the other hand, refused to work on Sunday. Finally Max decided to make Tuesday the day of rest, since no practicing religion had its feast-day on Tuesday.' p.188, Trümpler (2001b)

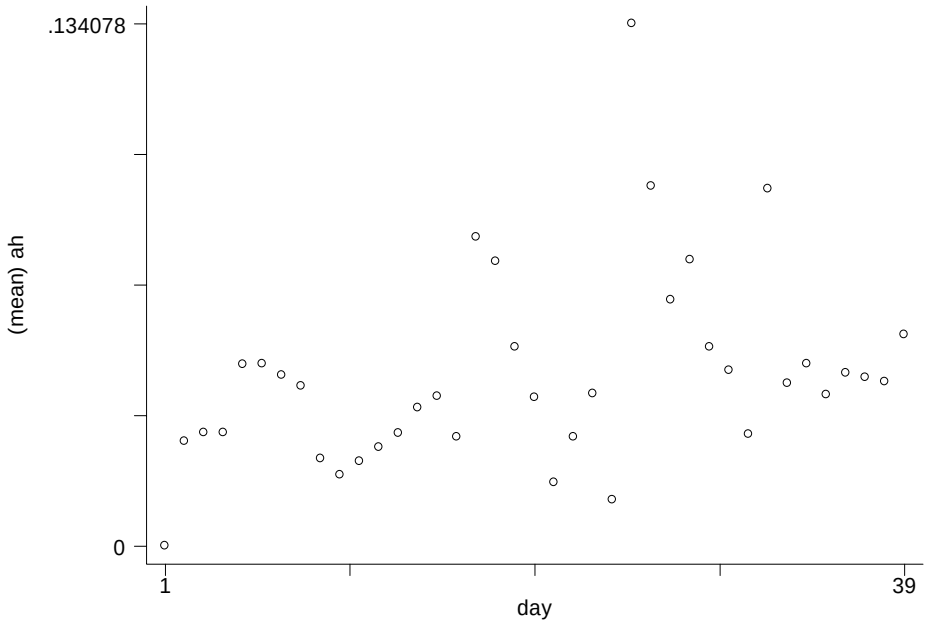
It is clear from the pay book that there is a high degree of turnover with workers coming and going a lot. Also the composition of the gangs changed a lot – although for the most part there was at least one or two names which remained the same throughout most of the weeks. It is conceivable that this person was a gang leader or foreman of some kind.

Table 2: Summary Statistics of Data (NT = 8829)

Variable	Mean	Standard Deviation	Min	Max
Absence	0.0445	0.2062	0	1
Bakshish (k)	7.8287	12.2147	-8	252

Figure 4 graphs the daily absence rate at the dig over the 39 days of the dig. Again we can clearly see the cycle of the week's activities as absence is higher at the beginning of each week and very low at the end of the week when pay day comes.

Figure 4: Daily Absence Rate at the Tell Brak dig



A simple investigation of the relationship between Bakshish payments over successive time periods reported in Tables 3a, b show that there is autocorrelation of these payments over time. As one might expect the payment of Bakshish on any one day is statistically associated with payments of the previous day even if the order of the day in the cycle of the dig is controlled for. We might expect this to be the case if a worker begins unearthing a collection of related objects within a small location he will go on working on this area in successive days.

Table 3a: Estimation of $k_t = \alpha + \rho k_{t-1} + \varepsilon_t$ (NT = 8829)

Variable	Coefficient (SE)	Coefficient (SE)
Const	5.1196 (0.1497)	1.1072 (0.2336)
Bakshish $(k)_{t-1}$	0.3581 (0.0113)	0.2905 (0.0114)
Day		0.2539 (0.0115)

Table 3b: Estimation of $k_t = \alpha + \rho k_{t-1} + \varepsilon_t$

(NT = 8829) with fixed effects for days

Variable	Coefficient(SE)
Const	6.0223 (0.1435)
$Bakshish_{t-1}$	0.2388 (0.0113)

Tables 4a and 4b set out the main results of the labour supply or absence decision. We estimate the model described in the previous section relating to the probability of each worker working on each specific day. In total our model is estimated for 823 workers over a total of 8829 working days. Both the logistic and the logistic model with unobserved heterogeneity and the fixed and random effects models indicate that there is a negatively significant effect of lagged Bakshish payments on the probability of absence the next day. The size of the coefficient varies between -.05 and -.0528 according to the specification. The final specification in last column of Table 4a is an attempt to control for both the weekly effects we graphed in Figures 3 and 4 and the cycle of natural cycle of the dig. Hence we use dummies to control for: the first day in each week, each week of the dig and these two variables interacted. We also experimented with other similar specifications.

Table 4a: Model for Daily Probability of Absence.

Standard Errors in Brackets (N = 823, NT = 8829)

Variable	Logistic	Logistic (Unobserved heterogeneity)	Logistic (Unobserved heterogeneity
Constant	-3.6989 (0.1200)	-3.9473 (0.1891)	-4.2873 (0.2734)
Lag Absence	4.4298 (0.1645)	4.0343 (0.2514)	4.3480 (0.2726)
$Bakshish_{t-1}$	-0.0500 (0.0161)	-0.0504 (0.0164)	-0.0528 (0.0218)
Start week II			0.0220 (0.6207)
Start week III			2.6299 (0.3853)
Start week IV			2.6706 (0.3521)
Start week V			2.2367 (0.5113)
Week II			-0.2412 (0.2508)
Week III			-0.3453 (0.2622)
Week IV			-0.0141 (0.2634)
Week V			0.2499 (0.3226)
Start weekII*lagbak			0.1318 (0.0466)
Start weekIII*lagbak			-0.0127 (0.0759)
Start weekIV*lagbak			0.0616 (0.0452)
Start weekV*lagbak			0.0419 (0.0353)
σ		0.7908 (0.2349)	0.9119 (0.2411)
LnL	-973.6717	-971.3413	-887.4383

Table 4b: Fixed effects Model for Daily Probability of Absence.

Standard Errors in Brackets (N = 120, NT = 1995)

Variable	FE Logistic
Lag Absence	1.9686 (0.1728)
Lag Bakshish	-0.0627 (0.0193)
LnL	-504.9457

These estimations still show clearly that we have a negatively significant coefficient on the lag of Bakshish payments. Hence the results clearly indicate a negative effect of the value of the lag bakshish payment on the probability of absence.

The implied elasticity that follows from our estimates we compute as follows

$$\eta_{h,x} = \frac{\partial E(h)}{\partial x}\frac{\bar{x}}{\bar{h}} = \frac{\bar{h}\partial P}{\partial x}\frac{\bar{x}}{\bar{h}} = \frac{\partial P}{\partial k}\frac{\partial k}{\partial x}\bar{x} = \frac{\partial P}{\partial k}\bar{x} \qquad (11)$$

for the estimation we have done the value of the elasticity is between 0.1012 (for the random effects model) and 0.1202 (for the fixed effect) . These are very similar to the figures obtained both by Altonji (1986) and MaCurdy (1981)

VII Conclusions.

We have used a unique dataset which has by chance survived from 1938 to analyse the labour supply of archaeological workers on a dig in north-east Syria in that year. By piecing together knowledge on the way in which these workers were paid, we are able to present results which we argue are consistent with the theory of intertemporal labour supply. That is, if workers receive unanticipated and transitory shocks to their wage rate they will increase their labour supply in response or alternatively be less likely to be absent on the following day.

It should be stressed that these results are at present preliminary as there remains further econometric investigation to carry out. Firstly we would wish to examine the possibilities that the membership of gangs and who one works with might make a difference to bakshish payments. Secondly we would wish to assess whether the level of cumulative aggregate payments to any individual worker might affect their bakshish payments. Finally although we have treated out data exclusively as if it were a model of absence behaviour. One could alternatively think of this as a model of labour supply. This further work would require us to work with notional daily wages instead of simple bakshish payments. This would have some disadvantages but one important advantage – namely that of being able to explicitly estimate a inter-temporal labour supply elasticity which would be directly comparable

to the rest of the literature. This further work remains on the agenda for the next version of this paper.

References

Altonji, J.G. (1986) 'Intertemporal substitution in labour supply: evidence from micro data', *Journal of Political Economy*, 94, (3),: S176-S215.

Barmby, T (2002) "Worker Absenteeism: A Discrete Hazard Model with Bivariate Heterogeneity" *Labour Economics* Vol 9 pp 469-476

Barmby T, Orme C and Treble J (1991) "Worker Absenteeism: an analysis using microdata" *Economic Journal* Vol 101 March 214-229

Barmby T, Orme C and Treble J (1995) "Worker Absence Histories: A Panel Data Study"*Labour Economics* Vol 2(1) 53-65

Camerer, C, Babcock, L, Loewenstein, G. and Thaler, R. (1997) 'Labor supply of New York City cabdrivers: One day at a time', *Quarterly Journal of Economics*, pp.407-441.

Carrington, W. J. (1996) 'The Alaskan labor market during the pipline era', *Journal of Political Economy*,104, (3),: 186-218.

Farber, H. S. (2003) 'Is tomorrow another day? The labor supply of new York city cab drivers?, Princeton University Working Paper #473.

MaCurdy T E (1981) "An Empirical Model of Labor Supply in a Life-Cycle Setting" *Journal of Political Economy* 89 (6) pp 1059-85.

McCall, H. (2001a) 'The Life of Max Mallowan: Archaeology and Agatha Christie', The British Museum Press, London.

McCall, H. (2001b) 'Max Mallowan', in Trümpler, C. (2001)

Oettinger, G.S. (1999) 'An empirical analysis of the daily labor supply of stadium vendors', *Journal of Political Economy*, 107 (2) : 360-392.

Treble J G (2003) "Intertemporal Substitution of Effort: Some Empirical Evidence" *Economica* Vol 70 pp 579-95

Trümpler, C. (2001a) 'Agatha Christie and Archaeology', The British Museum Press, London.

Trümpler, C. (2001b) 'Le camping begins': Life on an archaeological site in the 1930s', p.163-204 in Trümpler, C. (2001).

Trümpler, C (2001c) 'Introduction' in Trümpler, C. (2001a).