ISSN 0143-4543

University of Aberdeen Business School

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Incentives and Labour Contracts on Archaeological digs in Northern Syria in the 1930s

By

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Discussion Paper 2006-01
January 2006

Editor: Dr W David McCausland
www.abdn.ac.uk/business/

The Riddle of the Sands?
Incentives and Labour Contracts on Archaeological digs in Northern Syria in the 1930's.

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December 2005

Abstract.

This paper analyses data on the daily work decisions of archaeological workers on a Syrian archaeological dig in 1938. The remuneration contract that these workers faced involved a fixed component and a stochastic component termed "bakshish" which were daily payments for small finds that the worker made on the dig. The value of these finds we argue represent transitory movements in the worker's wage which can be used to examine intertemporal labour supply behaviour.

JEL classification: J22, J30, J40.

Keywords: Intertemporal labour supply, Bakshish.

[1] We would like to especially thank Henrietta McCall and the British Museum for permission to use Max Mallowan's 1938 wage book from Tell Brak, also Matthew Johnson for initial details on the nature of archaeological digs, Victor Winstone for helpful suggestions, James Dolton for transcribing the data onto the computer, Makram Larguem for help with the names of the workers, Rania Kamla and Mohammad Qurieshi for advice on Syrian currency, John Treble, Gauthier Lanot, Bob Hart, and Tatiana Kornienko as well as seminar audiences at Lancaster, Loughborough, Berlin(WZB), Stirling, Paris II, LSE, the WPEG conference at Royal Holloway College for helpful comments and last but not least to Martin Robson and Tony Cleaver for suggesting "The Riddle of the Sands" as a possible title. All remaining errors are of course ours. Address for correspondence, Tim Barmby, Department of Economics, Edward Wright Building, University of Aberdeen, Old Aberdeen, Scotland, AB24 3QY, tim.barmby@abdn.ac.uk, peter.dolton@rhul.ac.uk

I. Introduction.

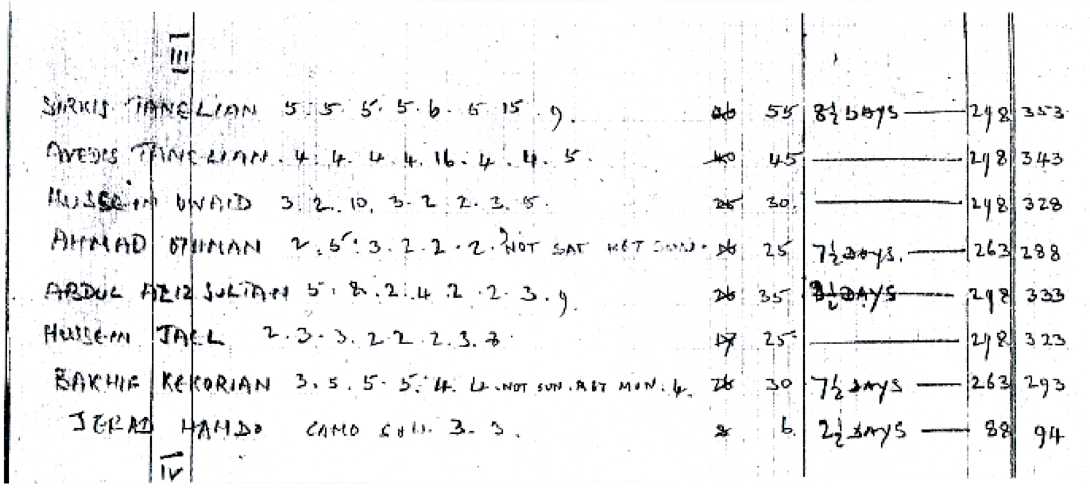
This paper analyses the daily labour supply or attendance decisions of workers employed on an archaeological dig in Northern Syria in 1938. We argue that this particular labour market is an attractive one to study if the intertemporal labour supply hypothesis is of interest. The reason for this is that under the payment system we observe on the dig, for which we have data, the daily wage data had a stochastic element which consisted of payments (which were called *bakshish*[2]) for (small) finds that the worker makes on each day of the dig. This element of the remuneration we argue constitutes a transitory wage shock, and if we also have data on labour supply responses, which we do, then an examination of intertemporal labour supply is possible.

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 no direct data on worker effort [3] during this dig but we do not believe it to be so relevant to our analysis. What we have in mind is 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 will 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 supports 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[4] or break some small artefact. 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.

[2] Sometime spelt *baksheesh* or *bakshisk*
[3] The interested reader should consult Treble (2003) for a discussion where effort is more important.
[4] Indeed we report a quote later in the paper which suggests that there may well have been a real cost to working "too" fast as a broken find would attract less bakshish

The study is facilitated by the careful record keeping of the 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 in that year MM kept incredibly detailed handwritten records, of the daily labour supplied by each worker (by name) and the resulting wage payments made to them. Max Mallowan would tour the site towards the end of the working day, he would agree an amount for all the finds that an individual worker had made. The agreed amount would be recorded in his wage book and Max would take possession of the material. As we will argue later on this system gave incentives for careful and vigilant work[5]. 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.



So, for example, reading along the first line this worker, Sirkis Tanelian, received a total payment of 353 quresh (the local currency at this time) for his "week's" work over 8.5 days, (the half day was for settling up) 55 quresh in bakshish and 298 quresh basic pay (35 quresh a day plus 18 quresh for the half day). Also the pay book records the days worked by each worker – for example the fourth line down shows that Ahmad Othman did not work on Saturday but returned Sunday this

[5] The bakshish system seems therefore not to have suffered from the perverse incentives implicit in some payment systems employed by other delvers into past. It is reported, Swisher, Garniss and Lewin (2000) that Ralph von Koenigswald searching for the "missing link" in Java had offered to pay a fixed amount (10 cents) per piece of hominid bone, only to find their workers when they excavated a bone would then proceed to break it into as many pieces as practicable so as to maximise income.

"week". We find that there is hardly any ambiguity in these records; the reason for this is that MM used this book for settling up at the end of each "week" and he wanted to ensure that there were no time consuming disputes during this half day.

II. Background Information on the Tell Brak dig in 1938 and 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 in Oxford. '*he dug systematically to ensure comparison with finds at complementary sites both geographically and chronologically*.' McCall (2001b), p53.

We are fortunate to have lots of details on how the market for archaeological workers operated and specifically what the situation was in the Tell Brak dig in 1938 from the accounts of Agatha Christie[6] (who was Mallowan's wife) and the memoirs of Max Mallowan himself. The latter describes the nature of how the market worked as follows[7]:

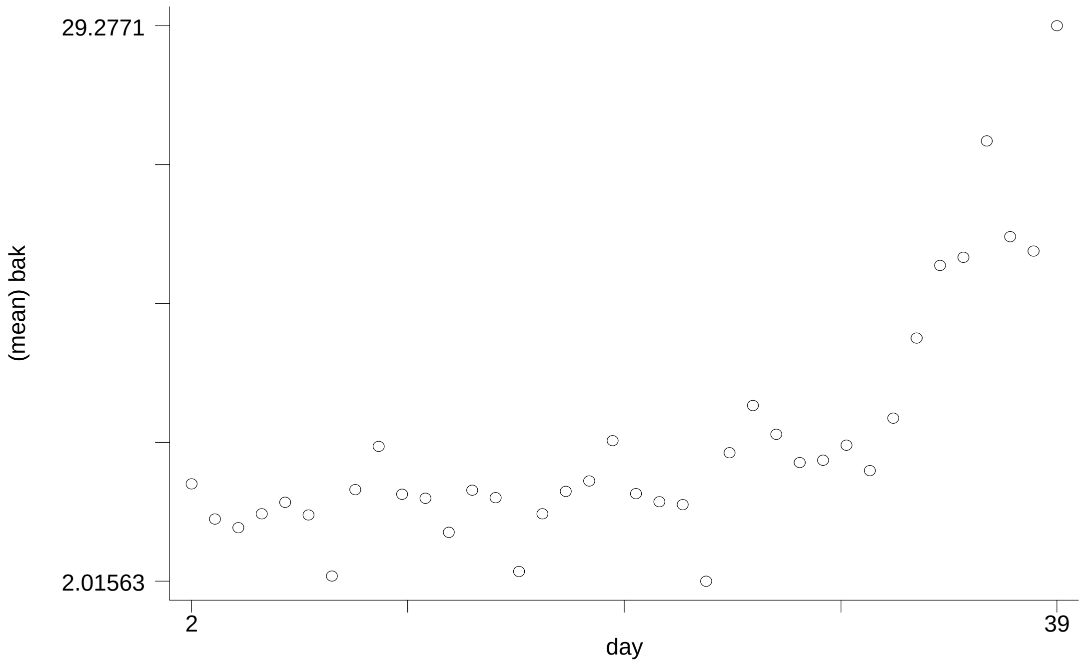
During the excavations we employed 200-250 men, sometimes less, sometimes more. They worked from sunrise to sunset with an interval of half and hour for breakfast and an hour for luncheon. It was a strenuous day's work for which they were paid at the rate of one rupee[8], the equivalent of about eighteen pence. In addition, bakshisk, that is tips, were awarded for all small finds as an encouragement to them to keep their eyes open. The gangs consisted of a pickman, a spademan and four, five or six basketmen according to the distance which the soil had to be carried.

The pattern of aggregate bakshish payments at Tell Brak in 1938 is reported in Figure 2. One might expect that the value of finds may be relatively modest at the start of a dig until a specific depth was reached. However the level of payments here seem 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 very 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

[6] See Christie Mallowan (1946)
[7] Mallowan (1977), p.43.
[8] Not actually rupees – just a convenient expression for foreign currency.

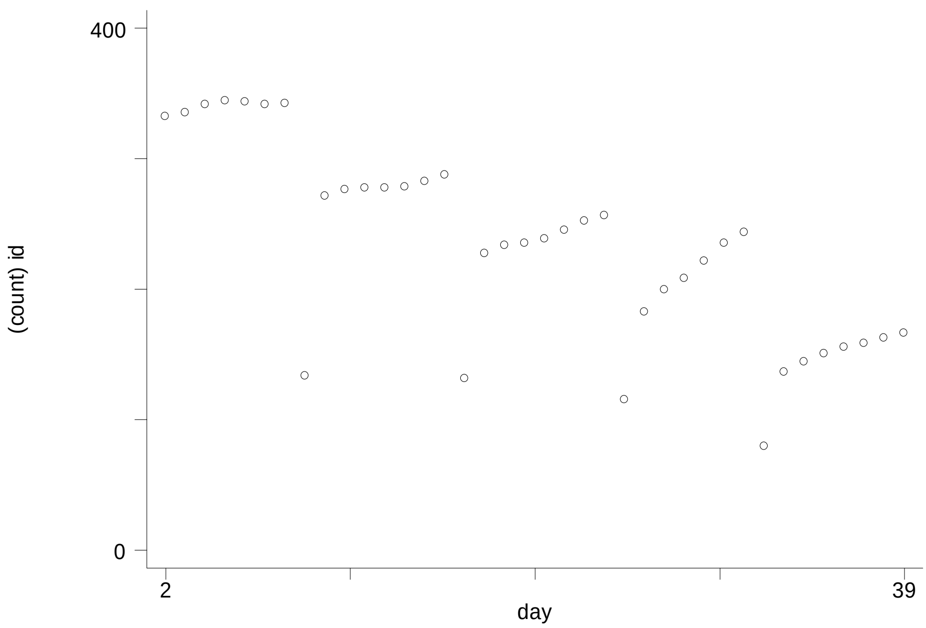
would run the risk of sacking. Later on such adjustments were very rarely observed, we presume that he judged he had found the correct level.

Figure 2: Aggregate Bakshish Payments at Tell Brak



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.

Figure 3 Number of workers



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. Over the life time of the dig, from week I to week V the net number of workers employed slowly falls as the work involved in the dig slowly exhausts itself. In wage book itself there were a small 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 some 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 or "week" (we return to this later) 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 and then return. In reality though the supply of workers was largely fixed at the beginning of the dig and then it was a question of trying to retain their services as time passed. Agatha describes the process of initial recruitment[9]:

'Once the work has been started on by the strangers from Jerablus, workmen from the spot hasten to be enrolled. The men of the Sheikh's village have already begun to work. Now men from neighbouring villages began to arrive by ones and twos. There are Kurds from over the Turkish border, some Armenians, and a few Yezidis …'

Once hired the men work in gangs. Agatha also describes how the gangs work[10]:

[9] Christie Mallowan (1946) , p.84.
[10] Christie Mallowan (1946) , p.85.

The system is a simple one. The men are organized into gangs. Men with any previous experience of digging, and men who seem intelligent and quick to learn, are chosen as pickmen. Men, boys and children are paid the same wage. Over and above that there is bakshish. That is to say, a small cash payment on each object found. The pickman of each gang has the best chance of finding objects. When his square of ground has been traced out by him, he starts upon it with a pick. After him comes the spademan. With his spade he shovels the earth into baskets, which three or four 'basket-boys' then carry away to a spot appointed as dump. As they turn the earth out, they sort through it for any likely object missed ….. not infrequently some small amulet or bead gives them a good reward.

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. The System of 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 supplementary 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)

Although we cannot distinguish from the data which individual in each gang was: the pickman, the spademan and the basket boys – it was the case that the basket boys earned the same daily rate as the others and could easily earn the same (or more) bakshish due to the small (but valuable nature) of some of the finds.

'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 and photographing the workers and acted a little like a spy – reporting workers who were hiding or asleep. 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. However in fixing the level of bakshish for an item MM would have explicitly kept the black market value of the object in mind. We know that other archaeologists used the system and recognised this feature – notably Sir Leonard Woolley[11]

'Payment of baksheesh is the best procedure for preventing carelessness and theft, according to Woolley. Some excavators still refuse to adopt this procedure, although by all experience bears out its wisdom….. Woolley notes each find and values it at the price a black market dealer might pay for the stolen object. On an average season the baksheesh bill may amount to 15 per cent of the wages. The gain to science is altogether out of proportion to the sum. In the first place there is no purloining of the finds, which would then be lost to science. In the second place the system trains the workmen to exercise extreme care during excavation, for baksheeh is paid only for objects which are not broken or damaged by clumsiness during exhumation. 'The system say Woolley 'does create an astonishing amount of good will'.

Sir Mortimer Wheeler makes similar observations in Wheeler (1956). Clearly paying the workers a reasonable value for their finds was rational. Agatha is even more explicit in terms of how objects may be valued[12]:

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[11] Ceram (1963), p.257.
[12] Christie (1936), p.44.

'You have to pay the workmen who find it the weight of the object in gold.'
'Good gracious!' I exclaimed. But why?'
'Oh it's a custom. For one thing, it prevents them from stealing. You see, if they did steal, it wouldn't be for the archaeological value but for the intrinsic value. They could melt it down. So we make it easy for them to be honest'.

Clearly then it would seem that the Bakshish payments are a rather ingenious way of trying to encourage the right incentives in the workers to be observant, but work carefully and honestly declare their finds at the end of each day. Without this system the output of the workers in terms of the quantity and quality (completeness) of the finds would be significantly impaired.

There are two other features of the bakshish system which turn out to be very convenient for our purposes. Firstly the nature of the finds is not related to worker effort and secondly there is a large element of randomness in when and how the finds are made. Two further quotes illustrate these ideas, firstly on the randomness of finding artefacts[13]:

There is no doubt that to the workmen, gamblers all by nature, the uncertainty of the business is its principal attraction. And it is astonishing how a run of luck will attend certain gangs. Sometimes when new ground is being broken Max will say: 'I shall put Ibraham and his gang on this outer wall; they've found far too much lately. Now poor old Rainy George has had no luck lately. I'll put him on to a good place'.
But lo and behold! In Ibraham's patch, the houses of the poorest quarter of the old city, straightaway is found a cache of an earthenware pot containing a heap of gold earrings .. and up goes Ibrahim's baksish; and Rainy George digging in a promising cemetery area where finds should abound, gets unaccountably sparse burials.

And secondly on the observation that the work was not productively related to effort[14]:

'It is true that they work in what may be called leisurely fashion, with only occasional spurts of frenzied digging or running when a wave of gaiety sweeps over them, but it is all really hard manual labour'.

What these observations suggests is that the worker cannot strategically decide to put in extra effort to try to alter their wage. The logic is that the archaeological worker is faced with a routine task, digging monotonously and carefully for items all

[13] Christie Mallowan (1946) , p.96.
[14] Christie Mallowan (1946) , p.153.

day long. 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 – and indeed digging faster may result in missing some small object or breaking an object which would mean less bakshish. As we have noted from the standpoint of our economic model this is a very convenient feature of our modelling as it means that the worker is not making any decision other than whether to supply his labour on a given day – conditional on their past bakshish payments (and the relative size of expected future bakshish payments).

IV The Literature on Intertemporal Labour Supply.

In broad terms the intertemporal labour supply hypothesis predicts that workers will respond to upward shifts in their wage 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 a negligible effect on income.

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 fully anticipated.

Some subsequent studies have tried to exploit specific aspects of certain labour markets to identify these intertemporal effects, and this study is clearly 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 have very short time horizons and will be more like to quit work when they receive a sudden, unanticipated increase in daily income. Farber (2005) however conjectures that this counterintuitive result could be due to problems with instrumenting the cab drivers wage, Farber also raises questions regarding the appropriate empirical methodology for such situations.

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 by instrumenting the demand by crowd size. Although the conclusions of this paper are credible it potentially suffers from two logical drawbacks. Firstly, the games are not on consecutive days and hence the labour supply decision is being played out over a whole season but only on isolated match days – this means that the connection between the last match shock to earnings and the decision to supply labour at the next match could be separately by some considerable delay. Second the wage determination in this model is clearly endogenous – and although the author takes great pains to try to circumvent this we would still wish to know if the result on the elasticity estimate is sensitive to this IV modelling technique.

A further point about the literature is that there is an important difference in the time periods over which the labour supply decisions are made. In the case of Oettinger (1999) the decision relates to supplying a days labour at intervals of up to 2-3 weeks apart, in the case of Altonji inferences are being made about intertemporal labour supply by looking at consecutive years decisions. We suggest that none of these time intervals is ideal and the results of estimation could be sensitive to the time interval in the data.

The model of intertemporal labour supply could ideally be best tested in a situation in which individuals receive truly random transitory shocks to their earnings in a given time period and then observe their labour supply decisions in a sequence of contiguous time periods thereafter with all other supply and demand decisions held constant. 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. This is not to say that we don’t need to take account of the participation decision that workers will make in choosing whether to present themselves at the site for a “weeks” work; we will return to this later.

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 (by their own observation). 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.

V An Economic Model of Labour Supply (and Absence) for Archaeological workers.

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 in a future period provided the substitution effect of the extra payment outweighs any possible income effect of the additional payment. This is in line with conventional wisdom (see Altonji (1988), Camerer *et al* (1997), Oettinger (1999) amongst others.

In this section we simplify the analysis to it's essentials. We will assume that the representative worker has a utility function defined over (daily) earnings, *x*, and (daily) non-work time, *l*.

$$U_t = \beta_1 x_t + \beta_2 l_t + \varepsilon_t \qquad (1)$$

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

$$\begin{aligned} U_t^A &= \beta_2 T + \varepsilon_t^A \\ U_t^W &= \beta_1 x_t + \beta_2 (T-h) + \varepsilon_t^W \end{aligned} \qquad (2)$$

where $\beta_1, \beta_2 > 0$ and *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:

$$x_t = x_B + k_t \qquad (3)$$

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

$$
\begin{aligned}
t=1: &\quad k_1 = \alpha + v_1 \\
t>1: &\quad k_t = \alpha + \rho(k_{t-1} - \alpha) + v_t = \alpha(1-\rho) + \rho k_{t-1} + v_t
\end{aligned} \tag{4}
$$

Where α is a constant, $0 < \rho < 1$ is the simple autocorrelation persistence effect of bakshish in consecutive time periods (capturing the idea that if a worker's bakshish at t-1 is higher than average his expected bakshish at t is higher) and v is a random white noise component. The constant α is the unconditional expectation of bakshish $E(k_t) = \alpha \ \ \forall t$, however, the conditional expectation is

$$
E(k_t \mid k_{t-1}) = \alpha(1-\rho) + \rho k_{t-1} \quad t \geq 2 \tag{5}
$$

The stochastic aspect of the bakshish payments makes the utility of work stochastic. The probability of observing the worker absent at time t can therefore be written as

$$
\begin{aligned}
P_t &= P(U_t^A > U_t^W) \\
&= P(\beta_2 T + \varepsilon_t^A > \beta_1 E(x_t) + \beta_2(T-h) + \varepsilon_t^W) \\
&= P(\beta_2 T + \varepsilon_t^A > \beta_1(x_B + E(k_t \mid k_{k-1})) + \beta_2(T-h) + \varepsilon_t^W) \\
&= P(\beta_2 T + \varepsilon_t^A > \beta_1(x_B + \alpha(1-\rho) + \rho k_{t-1}) + \beta_2(T-h) + \varepsilon_t^W) \\
&= P(\beta_2 h - \beta_1(x_B + \alpha(1-\rho) + \rho k_{t-1}) > \varepsilon_t^W - \varepsilon_t^A) \\
&= P(\alpha^* - \beta_1 \rho k_{t-1} > \varepsilon_t^W - \varepsilon_t^A)
\end{aligned} \tag{6}
$$

where $\alpha^* = \beta_2 h - \beta_1(x_B + \alpha(1-\rho))$ and since $\beta_1, \rho > 0$ the implication is that probability of absence will be negatively related to past bakshish, and this variable should be included in our empirical estimation of the probability.

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 recorded 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. We can partially infer from the names the ethnic origin of the workers and their gender[15], it was generally believed that the workforce on these digs was entirely male, however we find a small proportion that have female names. These we think are not women, but younger girls employed to sift through the rubble. The predominant ethnic group was Arab, around 80%, some Turks, just short of 10%, and also some Kurds, Persians, and a remainder whose ethnic group was unclear. Gender or Ethnic origin don't really have any significant effect on either absence within week or participation, the only significant effect found is being of Arab descent.

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[16].

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[15] We are particularly indebted to Makram Larguem for help in this regard
[16] On more than one occasion there is a note in the pay book of a person returning home to their village to plough.

Workers work for a period 'weeks' beginning on a specific day and working for up to eight with half a day added for administering the pay. Hence the week is not a conventional week. Then there were two or three rest days 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	Days off at the end of the week
I	28/3/38	4/4/38	8	1	8	42	342	Tue, Wed
II	7/4/38	14/4/38	8	9	16	37	290	Fri, Sat
III	17/4/38	24/4/38	8	17	24	31	258	Mon, Tue, Wed
IV	28/4/38	3/5/38	7	25	31	29	242	Thurs, Fri
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 degree of turnover with workers coming and going quite a lot. Also the composition of the gangs changed – 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 but this is not verifiable so we do not attempt to condition for this in our analysis.

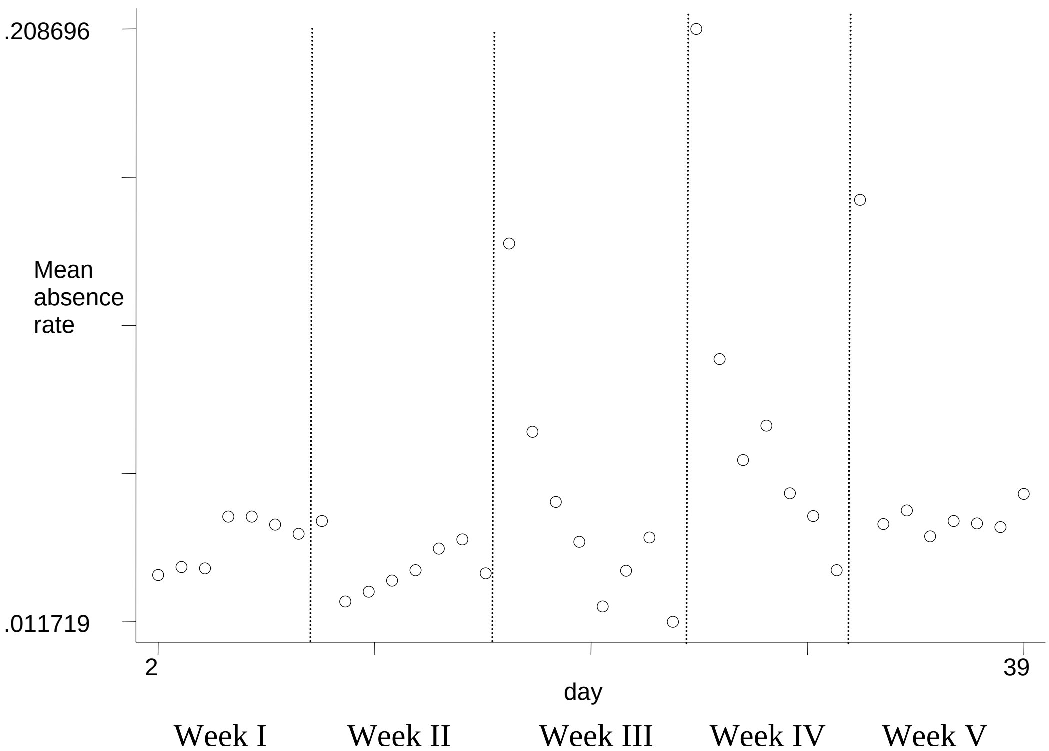
Table 2 presents the basic summary statistics which show that average daily bakshish of nearly 8 quresh was around 22% of the average daily fixed wage (which was 35 quresh). The table also shows us that the absence rate on any given day was fairly low at a little under 3%.

Table 2: Summary Statistics of Data (NT = 8159)

Variable	Mean	Standard Deviation	Min	Max
Absence	0.0292	0.1683	0	1
Daily Bakshish (quresh)	8.0559	10.9795	-5	250

The negative daily minimum in the previous table was a fine, however there were very few of these. 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 3 show that there is autocorrelation of these payments over time. The first order autocorrelation coefficient estimate varies from 0.37 to 0.23 depending on whether specific days are controlled for (Specification II) or whether fixed effects (for the days) is modelled explicitly (Specification III). 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 3: Estimation of $k_t = \alpha + \rho k_{t-1} + \varepsilon_t$ (NT = 8159)

Variable	Specification I Coefficient (SE)	Specification II Coefficient (SE)	Specification III FE Coefficient (SE)
Const	5.1155 (0.1605)	0.9994 (0.2401)	6.2672 (0.1532)
Bakshish $(k)_{t-1}$	0.3730 (0.0118)	0.2917 (0.0120)	0.2300 (0.0119)
Day		0.2718 (0.0121)	

It is clear from Figure 3 in particular, that there is significant variation in the pattern of participation over the 5 “weeks”. Two facts seem of particular relevance. In the first week we observe almost 400 workers on the site, by the fifth week this has diminished to less than 200. Also if we observe that over the whole 5 “week” period we observe 823 unique names entered in the wage book. Table 4 provides a breakdown of the participation patterns observed.

Here we see that a large proportion (67%) of workers work only for one week and a further 16% work only for two weeks. Of those who work for two weeks or more a large fraction work for two consecutive weeks. This suggests that the problem of travelling to and from the site to remote villages is an important factor in decisions to participate in any given week. Our modelling of absence is explicitly on specific day(s) with the ‘week’. In the econometric estimation in the next section we first model absence alone and then we model daily absence jointly with weekly participation. We do this in order to examine the possible endogeneity of the two decisions (absence and participation) and also to see whether our estimates of the intertemporal labour supply elasticity is robust to such considerations.

Table 4: Participation patterns at the Tell Brak dig.

Pattern		Week 1	Week 2	Week 3	Week 4	Week 5	Total
1	One week	1	0	0	0	0	184
2		0	1	0	0	0	94
3		0	0	1	0	0	91
4		0	0	0	1	0	104
5		0	0	0	0	1	83
6	Two weeks	1	1	0	0	0	50
7		0	1	1	0	0	17
8		0	0	1	1	0	21
9		0	0	0	1	1	12
10		1	0	1	0	0	7
11		1	0	0	1	1	11
12		1	0	0	0	1	1
13		0	1	0	0	1	1
14		0	0	1	1	1	4
15		0	1	0	1	0	6
16	Three Weeks	0	0	1	1	1	7
17		1	0	0	1	1	1
18		1	1	0	0	1	2
19		1	1	1	0	0	30
20		0	1	0	1	1	4
21		0	1	1	0	1	7
22		0	1	1	1	0	15
23		1	0	1	1	0	7
24		1	1	0	1	0	7
25		1	0	1	0	1	1
26	Four Weeks	0	1	1	1	1	7
27		1	0	1	1	1	2
28		1	1	0	1	1	6
29		1	1	1	0	1	4
30		1	1	1	1	0	13
31		1	1	1	1	1	24
Total		350	288	257	261	177	823

VII. Econometric Estimation.

To empirically implement eqn (6) we use data on the realisation of worker attendance, define the event

$$(d_{it} \mid w_{ik} = 1) = \begin{cases} 1 & \text{worker i attends work on day t | participates in week k} \\ 0 & \text{worker i doesn't attend on day t| participates in week k} \end{cases} \quad (7)$$

and noting the equivalence between the following two events

$$(d_{it} = 1 \mid w_{ik} = 1) \equiv (U_t^A > U_t^W) \tag{8}$$

The appropriate econometric structure we argue is a discrete panel data model Heckman (1981). This has been used in the analysis of absence patterns before, see Barmby, Orme and Treble (1992,1995). The probability of the event in (8) is building on section IV is

$$P(d_{it} = 1 \mid w_k = 1) = P(\alpha^* + \beta k_{it-1} + v_{it} > 0 \mid w_{ik} = 1) \tag{9}$$

where $v_{it} = \varepsilon_t^A - \varepsilon_t^W$ if the individual ε_t^j $j = A,W$ are independent extreme value type I random variables then v_{it} will have a Logistic CDF, which we denote *F*. Following Heckman we augment the specification of our probability to incorporate structural dependence by adding lagged absence as a regressor (this will pick up the effect of sickness). Thus we model the probability of the event of a worker not attending on a given day given that he attends as

$$P(d_{it} = 1 \mid w_{ik} = 1) = F(\alpha^* + \beta k_{it-1} + \gamma d_{it-1} \mid w_{ik} = 1) \tag{10}$$

the likelihood contribution again given that he attends would be

$$L_{ik}(\alpha^*, \beta, \gamma) = \sum_{t=1}^{T_W} \begin{matrix} [d_{it} \ln F(\alpha^* + \beta' k_{it-1} + \gamma d_{it-1} \mid w_{ik} = 1) \\ +(1-d_{it}) \ln(1 - F(\alpha^* + \beta' k_{it-1} + \gamma d_{it-1} \mid w_{ik} = 1))] \end{matrix} \tag{11}$$

T_w being the number of days worked that 'week'. The full likelihood is

$$\ln(\beta, \gamma) = \sum_{i=1}^{N} \sum_{k=1}^{NW} w_{ik} \ln(L_{ik} P(w_{ik} = 1)) + (1 - w_{ik}) \ln P(w_{ik} = 0) \tag{12}$$

where *NW* is number of weeks. 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.

Table 5 sets out the main result on the absence decision of the worker. We estimate the model described above relating to the probability of each worker working on each specific day, (in this estimation we are essentially assuming $P(W_{ik} = 1) = 1$ ie weighting the likelihood contributions equally) in equation (12) we return to modelling participation simultaneously shortly. In total our model is estimated for 823 workers over a total of 8159 working days. Our main estimation uses a Logistic model this indicates that there is a negatively significant effect of lagged Bakshish payments on the probability of absence the next day.We also attempt to control for both the weekly effects we graphed in Figures 3 and 4 and the natural cycle of the dig. Hence we use dummies to control for: each week of the dig and the last day of the week. We also experimented with other similar specifications but the qualitative conclusions were very similar. We also experimented with allowing for unobserved effects in a Fixed Effects framework and found that the results were not qualitatively different, These results are reported in Appendix 1.

Table 5: Logistic Models for Daily Probability of Absence. * indicates significant at 5% level (N = 823, NT = 8159)

Variable	Coefficient (SE)
Constant	-3.8002* (0.2418)
Lag Absence	5.7251* (0.2149)
Lag Bakshish	-0.0409* (0.0169)
Arab	-0.4957* (0.2101)
Week Dummies	Yes
End of Week Dummies	Yes
LnL	-586.1014

Hence the results clearly indicate a negative effect of the value of the lag bakshish payment on the probability of absence.

We now consider the model in which the absence and participation decisions are modelled jointly. We also model the probability of participating in a given week as

$$P(W_{ik} = 1) = \frac{1}{1 + \exp(-\theta_1 - \theta_2 week - \theta_3 Arab)} \qquad (13)$$

The actual participation proportions over the 5 weeks can be observed from Table 4 as 350/823 = 0.43, 288/823 = 0.35, 0.31, 0.32, 0.22. The estimates below indicate predicted participation propensities of 0.4257, 0.3684, 0.3147, 0.2654, and 0.2215 respectively. Referring back to the likelihood in equation (12), this structure can be interpreted as weighting the L_{ik} components by the probability of participation; in the estimation in Table 6 we weight the absence history of, say, pattern 25 from Table 4 by the (estimated) probability observing that particular participation *pattern.*

There are two ways of interpreting these participation probabilities. Firstly they represent a decision of the worker, for instance outside opportunities, unobserved to us, such as tending of crops etc, are causing workers to be less likely to return to the site as weeks progress. A second interpretation would be that this reflects Mallowan’s demand preferences, so a positive coefficient on Arab would indicate he is less likely to lay off Arab workers. We should emphasise that we have found no evidence in the descriptions of the way Mallowan organised his digs to suggest that he laid off workers in any systematic way, but since modelling demand influences has been an important part of this particular labour supply literature, it is important that our empirical approach can accommodate this.

Table 6: Simultaneous Estimation of Within week Absence Equation and Weekly Participation (* significant 5% or better, † significant 10%)

	Variable	Coefficient (SE)
Absence	Const	-4.2205* (0.1379)
	Lag Absence	5.7589* (0.2031)
	Lag Bakshish	-0.0278* (0.0136)
	End of week (Eow) dummies	Yes
Participation	Const (θ_1)	-0.1318 (0.0878)
	Week(θ_2)	-0.2395* (0.0259)
	Arab (θ_3)	0.0721 (0.0457)
	LnL	-313.5219

The implied elasticity that follows from our estimates can be computed as follows. Since we do not observe variation on the daily hours (*h*) margin for workers (they either attend for the day or don't), we use our estimated probability of absence (*P*) to compute expected hours $E(h) = h(1-P)\pi$ where π is the probability of participation. Since there is no variation in daily hours $\partial E(h) = h\partial\pi(1-P)$. We consider the derivative of this with respect to daily earnings *x* where from equation (2) we see that $\frac{\partial k}{\partial x} = 1$. Evaluating quantities at their mean values for specification I in table 6 above gives

$$
\begin{aligned}
\eta_{h,x} &= \frac{\partial E(h)}{\partial x}\frac{\bar{x}}{\bar{h}} = \frac{\bar{h}\partial(\pi(1-P))}{\partial x}\frac{\bar{x}}{\bar{h}} = \frac{\partial(\pi(1-P))}{\partial k}\frac{\partial k}{\partial x}\bar{x} \\
&= \left[-\frac{\partial P}{\partial k}\pi\right]\bar{x} = \left[-\beta\bar{P}(1-\bar{P})\bar{\pi}\right]\bar{x} \quad \text{assuming } \bar{\pi} \simeq 0.3 \qquad (15) \\
&= \left[-(-0.0278)(0.0292)(0.9708)(0.3)\right](\frac{298}{8} + 8.0559) = 0.0107
\end{aligned}
$$

As can be seen, noting that the form of the probability function *P* is Logistic and β is the estimated coefficient on lag bakshish in the estimation in table 6the value of the elasticity is 0.0107.

It implies that an increase in the value of finds of, say, 25% would result in an increase in hours supplied of 0.275%. So at the moment on an 8 day (assuming 10 hours work per day) period for our 823 workers with and absence rate of 2.9%, there would be in aggregate 63931 hours worked per week, if the value of finds were 25% higher, then we would on the basis of these estimates expect between an extra 176 hours of work to be supplied per week.

VIII 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 northern Syria in that year. By piecing together knowledge on the way in which these workers were paid, we are able to present results that we argue are consistent with the theory of intertemporal labour supply. That is, if workers receive unanticipated and transitory shocks to their daily wage rate they will increase their labour supply in response, or alternatively be less likely to be absent, on the following day. Our suggestion is that we have been able to identify this effect because of the availability of data on daily bakshish payments to these archaeological workers which constitute exogenous, unanticipated shocks to income which are independent of any of the supply or demand influences which have beset other researchers attempts to identify this effect.

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Appendix I

Fixed effects Model for Daily Probability of Absence.

Standard Errors in Brackets (N = 79, NT = 952) * Sig at 5%

Variable	Coefficient (SE)
Lag Absence	2.3491* (0.2204)
Lag Bakshish	-0.0633* (0.0247)
Week Dummies	Yes
End of Week Dummies	Yes
LnL	-235.8642

These estimations still show clearly that we have a negatively significant coefficient on the lag of Bakshish payments, after accounting for individual fixed effects