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Honekamp, Ivonne
University of Bamberg

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Ivonne Honekamp

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Corresponding Author

Ivonne Honekamp, MSc
Otto-Friedrich-University Bamberg
Chair in Empirical Microeconomics
Feldkirchenstraße 21
96045 Bamberg
Germany
Tel. +49 951 863-2603
<http://www.uni-bamberg.de/vwl-mikro/leistungen/team/honekamp/>

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Abstract

Wages and their effect on labour supply are not only an important subject for labour economists who aim at measuring substitution and income effects. Additionally, the government is interested in the impact of policy changes on the labour market and companies would like to know if it is possible to increase labour supply and especially productivity by increasing the wage rate. This paper introduces a dynamic version of the traditional model of labour supply and presents model extensions and the underlying behavioural assumptions arising from empirical findings, psychology and neuroscience. It evaluates findings and behavioural assumptions derived so far.

None of the contributions investigated in this work is entirely free from criticism. The problem of analysing a comprehensive model of labour supply on the one hand, is the scarcity of suitable subjects to investigate and on the other hand, the individuality of each subject observed. With this work a critical analysis of existing research on labour supply decisions is provided. This shall contribute to motivate and ease future research in this area which has to take these problems into account.

Key Words

high wages; analysis; labour supply decision; labour supply model; intertemporal labour supply

JEL

J22, J31, J33

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1. Introduction

Wages and their effect on labour supply are not only an important topic for labour economists who aim at measuring substitution and income effects. Additionally the government is interested in the impact of policy changes on the labour market and companies would like to know if it is possible to increase labour supply and especially productivity by increasing the wage rate. Considering the theory of the competitive labour market, the market clears at a wage rate which is equal to the marginal revenue product of labour. As a result, involuntary unemployment falls to zero. However, this is not always the case; firms for example voluntarily pay above market clearing wages. If we assume that firms predominantly aim at maximising profits, then the generous wage must have a positive effect on workers productivity which outweighs the extra wage costs.

The neoclassical model of labour supply predicts that worker work harder (comprising longer hours) when there is a temporary wage increase, and increase their leisure time in times of low wages. The standard theory can best be tested in “an environment in which workers are free to choose when and how much to work and in which there is a salient relation between their effort and their income” (Goette, Huffman and Fehr 2003). This work critically reviews existing research on intertemporal labour supply decisions. The authors of these contributions question the validity of the traditional labour supply model. Furthermore, they test different theoretical extensions of the labour supply model against their findings. These extensions are predominately guided by behavioural regularities observed in the labour market or even studied in neuroscience. There seems to be consent among most of these researchers that a model with reference dependent preferences is the best one in predicting the empirical findings correctly. This model assumes that workers work towards a daily income goal and that they would experience psychological costs if they do not reach their target. This paper not only analyses behavioural models tested by the researches within their contributions but also suggests models which have not been evaluated against the empirical findings.

The paper is organized as follows. The second chapter introduces a dynamic version of the traditional model of labour supply. In the third chapter model extensions and the underlying behavioural assumptions arising from empirical findings, psychology and neuroscience will be presented. The last paragraph of chapter three evaluates findings and behavioural assumptions derived so far. Finally, the last chapter is the conclusion.

2. The traditional model of labour supply

The static labour supply model analyses the labour supply decision at a specific point in time. It is used to estimate the change in labour supply by comparing two static equilibrium situations. In the case of a wage change analysts would estimate the labour supply before the change and afterwards and then they compare the outcomes.

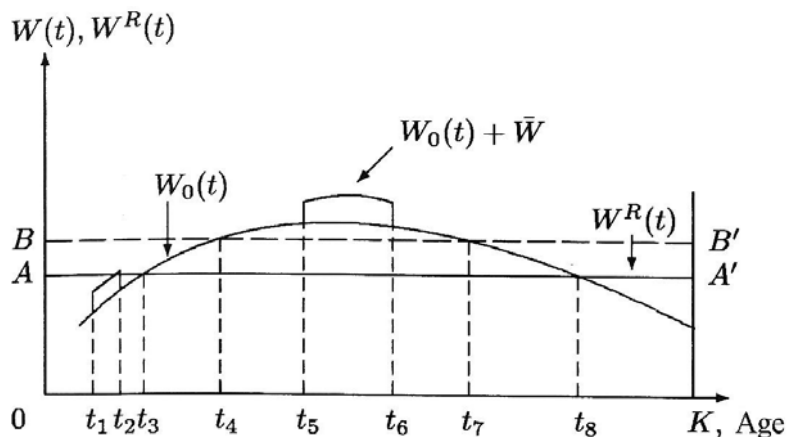


Figure 1: Dynamic model of Labour supply¹

A dynamic labour supply model on the other hand, as the one presented in figure 1, is interested in how a wage change does affect labour supply throughout the whole life or through an episode of an individual's life. That's why this model is also called life-cycle model of labour supply. The standard life cycle model assumes that an individual maximises the following intertemporal utility function:

$$U = \sum_{t=0}^K (1+s)^{-t} \cdot U[x(t), F(t); R(t), \mu(t)] \quad (1)$$

$$A(0) + \sum_{t=0}^K (1+r)^{-t} \cdot [W(t) \cdot H(t) - P(t) \cdot x(t)] \geq 0 \quad (\text{budget constraint}) \quad (2)$$

By choosing to participate in the labour market and to work a specific number of hours an individual maximises his/her life time utility (1)² which is subject to a budget constraint (2). Life time utility depends on the consumption opportunities $x(t)$ and the amount of leisure $F(t)$ at each point in time. The decision is influenced by individual characteristics $R(t)$ and unobserved individual heterogeneity $\mu(t)$ which affect the labour supply decision. It is assumed that the length of the planning horizon, period $t=0$ until K is known by the individual. Since people prefer consumption today compared to consumption in the future, they discount future consumption at a subjective interest rate s . The budget constraint

¹ Franz (2003).

² It is an additive and separable utility function.

constitutes the persons nominal wealth, $A(0)$, at time $t = 0$ and the discounted difference between the earned wage income and the consumption expenditure.³ This expression is assumed to be equal or greater than 0. The solution to the constrained maximization problem (1) and (2) can be observed in figure 1. The interesting question to be answered by this model is how a *temporary increase in the wage rate* changes the labour supply decision. The horizontal line AA' constitutes the reservation wage of the individual which depends on the market wage of each time period observed. As long as the market wage $W_0(t)$ is above the reservation wage, the individual will participate in the labour market. Between period t_5 and t_6 an anticipated wage increase \bar{W} occurs which leads to an increase in the reservation wage from AA' to BB'. This is because the higher wage decreases the marginal utility of wealth. Furthermore the model predicts a decrease in hours of work during periods not affected by the wage increase. The overall hours worked during the period $t = 0, 1, 2, \dots, K$ is, however ambiguous. Without further information about the size of the income and substitution effect it is not possible to determine whether hours of work over the life cycle increase or decrease.

The dynamic labour supply model presented above predicts that an anticipated temporary increase in the wage should be followed by a simultaneous increase of labour supply. This reasoning follows because such a wage increase does not affect lifetime wealth but raises the current price of leisure.⁴ The outcome might be less clear for unanticipated wage increases which affect lifetime wealth. Even in this case, however, the wealth effect should be tiny for a truly transitory wage change and therefore the labour supply elasticity should be positive.

3. Model extensions and behavioural assumptions

The following paragraphs, present empirical and experimental evidence which question the validity of the traditional labour supply model. The authors of these contributions test different theoretical extensions of the labour supply model against their findings. Their models are predominately guided by behavioural regularities observed in the labour market or even studied in neuroscience. A summary including the results and limitations of the contributions considered in the next paragraphs can be found in the Appendix.

3.1 Dynamic labour supply model with additive and separable utility

The dynamic labour supply model with an additive and separable utility function has been introduced in the previous chapter. This is the model which's validity has been questioned by

³ R is a constant interest rate, $H(t)$ the hours of work, $W(t)$ the wage per hour, $x(t)*P(t)$ the consumption expenditure.

several economists. It predicts that an anticipated temporary increase in the wage should be followed by a simultaneous increase of labour supply. By thinking about this prediction intuitively there seems to be no reason to believe that individuals might react differently. In all studies being discussed in this work, the wealth effect is negligible because of the temporary nature of the shocks or the empirical specification. Therefore the income effect is marginal or not present and the substitution effect should be positive during the time of the wage increase. This is because a wage increase raises the current price of leisure which leads to an intertemporal substitution of work for leisure.

Support for this model comes from Oettinger (1997, 1999) who analysed the participation decision of stadium vendors. He concludes that vendors are more likely to participate if expected earnings of the respective game are high. Faber(2005) also did not find a deviating behaviour while analysing the stopping behaviour of New York taxicab drivers. He assumes that a driver at a given point in his shift compares his utility if he stops working with his expected utility continuing to work. Both studies, however, do not allow making inferences on the overall labour supply. The analysis by Faber (2005) does not reflect the participation decision and the one by Oettinger (1997, 1999) does not allow reliable inferences about effort per game (Fehr and Goette 2005). Fehr and Goette (2005) themselves find a positive overall labour supply response in their field experiment at a bicycle messenger firm. Nevertheless, they detected forces which worked against the intertemporal substitution effect. The data provided the opportunity to study the effort decision and the decision to work a specific shift, as a response to a temporary wage increase. They found that the large positive effect on labour supply was exclusively driven by the increase in the number of hours worked. The labour supply elasticity of work effort on the other hand decreased in response to the wage increase. Here we are at a point where the traditional labour supply model is no longer able to explain the behaviour of the working population. Fehr and Goette (2005) tested two extensions of the labour supply model to find the one which would go conform to their data. These are the labour supply model with non-separable utility and a rational choice model with reference dependent preferences.

3.2 Labour supply model with non-separable utility

Employees who decide to work longer hours or more periods, as the bicycle messengers in the field experiment by Fehr and Goette (2005), may rationally decide to reduce effort per hour (per shift). The model with non-separable utility accounts for the fact that last periods effort

⁴ This model implication is also called the intertemporal substitution hypothesis.

raises this period's marginal disutility of effort. The model allows for the fact that workers who work more shifts will reduce their effort per shift. Therefore, the model is consistent with evidence from the bicycle messenger behaviour (Fehr and Goette 2005). The other model employed, the rational choice model with reference dependent preferences (RDP-Model), however, does also predicts the outcome derived in the experiment correctly.⁵ Why Fehr and Goette (2005), nevertheless, prefer the RDP-Model will be described in the discussion of the respective model below.

Goette and Huffman (2005, 2006) also consulted the labour supply model with non-separable utility to explain their findings. They investigated the within-day changes of effort decisions as a response to a wage increase for bicycle messenger working for the company for some time. They found that messengers work diligent early the day but relax later on. They call the analysed model a fatigue model. This is just another form of saying that high effort early in the day increases the marginal costs of effort later on. Again, utility is not separable the difference to the first paragraph of this section is that they study two versions of this model. The first one is fatigue with recovery which implies that after one period of leisure time, the individual recovers and proceeds with lower marginal costs in the next. The other version is fatigue without recovery, where a stock of fatigue is build up. Both models would predict an increase in effort along the whole day, hence not reflecting the decrease in effort later in the day.⁶ Given that the marginal cost of effort is sufficient convex, however, it could be that effort decreases as time goes by. Goette and Huffman (2005, 2006) therefore conclude that the fatigue model has not proved satisfactory in explaining their results. In the next paragraphs the already mentioned RDP-Model will be outlined.

3.3 Reference Dependent Preferences (RDP-Model)

Workers may have a daily income target which serves as a reference point. It is assumed that loss averse individuals will experience an additional psychological cost, if they fall short of their target. The marginal utility of an additional Euro earned below the target is therefore higher than the marginal utility above the target. Paying workers temporarily higher wages would mean that the reference point is reached earlier, reducing the marginal utility of income and inducing workers to provide less effort.

A daily income target has been seen as a plausible explanation of employee's behaviour in the studies by Fehr and Goette (2005) and Goette and Huffman (2005, 2006) who concentrated on bicycle messengers as well as for taxicab drivers as studied by Camerer

⁵ A description of the RDP-model see below.

et al. (1997). Bicycle messengers it is argued, are aware of how much money they earn from each completed delivery since they keep the receipts form each delivery they did on a shift. In a similar situation are taxicab drivers, so that both occupational groups may use an income target as a commitment device. This rule of thumb may turn out to be easier than attempting to keep track of how much money they earned over several shifts. Considerable research does exist “which suggests that people ‘bracket’ decisions narrowly” hence they isolate “decisions from the entire stream of decisions they are embedded in” (Read and Lowenstein 1996 in Camerer et al. 1997). A further reason brought about in favour of income targeting is that it helps workers to overcome a natural tendency to “shirk” that arises from a high marginal disutility of effort (Fehr and Götte 2005).

Camerer et al. (1997) estimate a model using data from daily wages and work hours of city cabdrivers in New York. They find a significant negative wage elasticity of hours worked. As a result of their estimates and interview with taxi fleet owners they conclude that driver “drive as if they have an income target, when they get near the target, the probability of quitting for the day rises sharply.” The findings of Camerer et.al (1997) ,however, have been questioned by several authors who argue that the econometric approach applied does not produce the true estimates of the wage elasticity. I will only mention two of the main criticisms. The first one is the endogeneity of the wage which, if not controlled for leads to a downward bias of the estimates as shown by Oettinger (1999). Secondly, fare opportunities vary dramatically and unpredictably over the day, thus it makes little sense to characterize a day by the average income per hour, as Camerer et. al. (1996) did. (Faber 2005).

Above it has been assumed that, especially, loss avers individuals exhibit additional psychological cost, if they fall short of their target. Exactly this reasoning brought Fehr & Goette (2005) to the idea of using a lottery to find out the degree of loss aversion of their experimental subjects.⁷ It turned out that the degree of loss aversion contributed significantly to the negative effort elasticity. These findings let them to conclude that the RDP-Model is more appropriate to explain a negative effort elasticity of their bicycle messengers than the model with non-separable utility.

A slightly different interpretation of the RDP-Model has been put forward by Goette and Huffman (2006). They claim “that workers on a piece rate are psychologically motivated to reach a daily income target on top of their purely financial motives to exert effort.” They back up their claim by referring to recent evidence from psychology and neuroscience which

⁶ For the derivation of the model please see Goette and Huffman (2006).

⁷ Bicycle messengers.

detected affect to be a source of generating this kind of behaviour. The within-day effort decision for their bicycle messengers has been modelled based on the interaction of two neural systems. The cognitive system is the one which leads to a behaviour as predicted by the standard labour model and the second is the affective system. This evolutionary older system induces people to work towards a goal and directs people to behave loss averse. Goette and Huffman (2006) found this version of the RDP-Model to be in line with their empirical observation that messengers work harder in early hours and less hard later on.

Every model presented under the headline of reference dependent preferences so far has assumed that the reference point is an exogenous variable. In other words, the income target of a worker does not change regardless of what happens. Köszegi and Rabin (2004) developed a model in which the reference point is endogenously determined. For taxi cab drivers this would mean that “a fully anticipated increase in the morning wage leaves the driver on average equally far from” his “target in the middle of the day and hence does not” affect his “willingness to continue work” (Köszegi and Rabin 2004). If this wage increase in the morning would instead be unexpected, the probability of a driver to continue work in the afternoon would decline. There is already evidence that this model does not fit each dataset. The wage increase in Goette and Huffman (2005, 2006) for instance is fully anticipated by the bicycle messengers; hence their reference income should be adjusted upwards. Therefore the effort decision ought to be the same as before the wage increase. It is not clear how many days after the wage increase were considered within their econometric specification. The intuition stands to reason that the reference income would at least adjust after workers have got used to earning a higher wage rate.

3.4 Evaluation

Dickinson (1999) points to the limitation of models which treat the choice of hours of work or the participation decision as the only variable of interest, when in fact many workers also make a calculated decision about the intensity or effort with which they work. In a controlled laboratory experiment⁸ Dickinson (1999) extends the classical model by allowing for a dual labour supply choice, namely hours of work and work effort. His results show that 65 per cent of the subjects displayed negative substitution effect on work effort. Furthermore 14 out of 26 subjects show a negative income effect which implies that on the job leisure⁹ is a normal

⁸ His subjects earned a piece-rate for each paragraph typed containing no more than five errors. On three days, on average two hours a day, they participated in the experiment. At the second day the pay rate either decreased or increased. This change was an unanticipated change for the subjects.

⁹ Examples for on-the-job leisure are coffee breaks, or staring out of the window. On the job leisure can also be interpreted as shirking or putting less effort into work.

good. Unfortunately his work does not allow reconstructing if the subjects with a negative (positive) substitution effect on effort also have a positive (negative) substitution effect on hours. Hence conclusions about behavioural patterns like income targeting or quitting work early because high effort leads to tiredness are not possible. Since, for reasons mentioned above, future research should concentrate on both, the hours decision and effort decision I am going to evaluate only the most recent research which does comply to this requirement. The only contributions considered in this work which analyse labour supply in this way is the work by Dickenson (1999) himself, the field experiment by Fehr and Goette (2005) and to a certain extent the research by Goette and Huffman (2005, 2006). All three contributions, however, have their limitations. Dickenson's work for example does not allow making any assumptions about underlying behavioural patterns. Future research could use the data collected by Dickenson and then analyse them to overcome this shortcoming. The contribution by Fehr and Goette (2005) researches the behaviour of bicycle messengers with respect to participation and effort decisions whereby the effort decisions are aggregated to the day. The result is that messengers choose to work more shifts in response to a temporary wage increase but exert less effort during each shift. The theoretical model fitting this behaviour is on the one hand the model implying that workers who choose to work longer hours rationally choose to reduce effort per shift. On the other hand stands the RDP-Model which is favoured by the authors.

It is, however, not clear from their work if a shift constitutes a fixed number of working hours or if there is room for messengers to quit early. Should there be some flexibility of choosing working hours, it would be interesting also to analyse the hours working decision. Nevertheless their research could be extended to include within-day effort decisions as suggested and applied by Goette and Huffman (2005, 2006). Goette and Huffman (2005, 2006) are able to infer that a wage increase leads to an increase in effort early in the day but to a reduction of effort in later hours. The behavioural model fitting these findings it is argued is the RDP-Model. The idea that effort ceases during the day as a result of fatigue has been rejected on grounds of the positive effort response predicted by the theoretical model. Additionally, Goette and Huffman (2003) conducted a survey among 114 bicycle messengers which reveals that an income target is predominant for most of the messengers (Goette and Huffman 2003 in Lorenz, Goette and Fehr 2003).

Goette, Huffman and Fehr (2003) point out that, "in particular, the RDP-Model can explain why higher financial incentives make workers more likely to show up for work, but at the same time can cause them to put in less effort on the job." This, however, would also be

the result of the shirking model derived by Becker and Stigler (1974). In this model companies have to set wages such that shirking can be prevented. Workers themselves compare on the one hand the expected wage (utility) in the case they do not shirk and the expected wage they would receive if they shirk whereby there is a certain probability that shirking will be detected. The probability to detect shirking would intuitively be higher if the worker responds to a wage increase by showing up later or quitting work earlier. An effort reduction during the day, however, is hardly observable by the firm.

Nevertheless, it might be reasonable to quit work early if one has supplied high effort early in the day instead of reducing effort for the rest of the day. In the research by Goette and Huffman (2005, 2006), however, the hours decision seems only of minor interest and it is not clear, if the reduction in effort results from being less ambiguous at the end of the day or from quitting early. This is the result of their econometric specification defining the dependent variable ‘the daily hourly labour supply’ as ‘hourly revenues’. If the messenger takes a long break which lasts at least one hour during his shift, the labour supply would be set to zero in the same way as if he quit for the day.¹⁰ Therefore it could also be possible that messengers reduce their hour’s labour supply instead of reducing effort towards the end of the workday. If it were indeed the case that messengers do quit early as a response to high effort at the beginning of their shift there exists an alternative model besides the RDP-Model which is promising in explaining the messengers labour supply decision.

This is the contribution by Chung-cheng (2003) which treats working hours and work effort as distinct variables in an efficiency wage model. By using a modified shirking model of Shapiro and Stiglitz (1984), he shows that a wage increase leads to two direct substitution effects that motivate workers to provide more effort and hours. Intuitively in the absence of an income effect, a higher wage rate increases the relative attractiveness of spending time at the workplace to off-the-job leisure as well as of spending time working to on-the-job leisure (shirking) (Chung-cheng 2003). Greater effort increases the marginal disutility of spending time at the workplace hence the worker reduces his hours spend on-the-job. If this cross substitution effect is large, the hourly labour supply may decrease in response to a wage increase. This model does not assume that individuals have something like a daily income target but rather that exerting effort is associated with high costs, similar to the fatigue model presented earlier.

¹⁰ Messengers have a typical shift of 5 hours on-duty, in which they also actively deliver Sendungen and the maximum workday is seven hours. This could explain why they reduce effort later in the day while they would prefer to quite even earlier. They are constrained by their shifts and not completely free to choose hours of work.

4. Conclusion

Empirical evidence on labour supply decisions of workers following a wage increase is mixed. There are authors like Oettinger (1997) and Faber (2005) who find support for the traditional labour supply model predicting labour supply to increase in response to a wage increase. Others, eg. Camerer et al (1997), Fehr and Goette (2005), Goette and Huffman (2005, 2006), find work effort to decrease as soon as a daily income target has been reached. Increasing a workers wage implies that a worker reaches his income goal earlier, reducing effort afterwards. Köszegi and Rabin (2004) suggest a model in which reference incomes are endogenous. Meaning that a fully anticipated increase in the wage leads to an adjustment of the reference income upwards, leaving the individual equally far from his income target as before the wage increase. This model, however, is not supported by all of the findings outlined above.

In explaining their results, be it the decrease of effort of bicycle messengers or the reduced number of hours worked by taxicab drivers; all authors favour the income target model with a fixed reference point as opposed to the fatigue model. Additionally there seems to be consent that labour supply decisions can only be reliably analysed if taking into account the hours (alternatively participation decision) as well as the effort decision of workers. While the last point is indisputable, in my opinion, the jury is still out on the behavioural explanation of these findings. The RDP-Model should not be taken as sole model being able to explain all the empirical findings. I have shown that fatigue as an explanation should not be abandoned completely since the formulation by Chung-cheng (2003) would also be able to predict such outcomes. There needs to be more evidence as the one by Fehr and Goette (2005) who have shown that individuals who are loss averse also act as if they have a reference income in mind. An interesting idea for future research would be to replicate the laboratory experiment by Dickenson (1999) in which it should be possible to control for most of the criticisms mentioned in this work.

None of the contributions investigated in this work is entirely free from criticism. The problem of analysing a comprehensive model of labour supply on the one hand, is the scarcity of suitable subjects to investigate and on the other hand, the individuality of each subject observed. Effort is difficult to observe and if it is feasible, it can only be monitored for a tiny group of occupations such that a generalization from these findings is not possible. With this work I have provided a critical analysis of existing research on labour supply decisions. This shall contribute to motivate and ease future research in this area which has to take these

problems into account. For the conclusion it remains to say that it is not yet possible to give any founded advice to companies of how to increase work effort of each individual employee.

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6. Appendix

Author	Investigation of	Anticipated*	Results	Interpretation	Limitations
Camerer et. al. (1997)	Hours decision of New York taxicab drivers	Partly	Negative elasticity of labour supply	Income targeting (Reference dependent preferences)	- endogeneity of the wage - characterizes a day by the average income despite sizable wage variation within the day - day to day variation small - effort decision neglected
Faber (2005)	Stopping decision of New York taxicab drivers	Yes	Increase in expected earnings raises the probability of participation	In line with neoclassical labour supply theory	- effort decision neglected
Oettinger (1997)	Participation and effort decision of stadium vendors	Yes	Increase in expected earnings raises the participation as well as the effort decision	In line with neoclassical labour supply theory	- relies on an untestable assumption about the form of the production function mapping unobserved effort into observed earnings
Oettinger (1999)	Participation decision of stadium vendors	Yes	Increase in expected earnings raises the probability to participate	In line with neoclassical labour supply theory	- effort decision neglected
Dickenson (1999)	Effort and hours decision in a laboratory experiment	No	Subject partly display negative substitution effects (SE) on effort and/or hours of work	Behavioural interpretation not possible	- does not allow to reconstruct if the same subjects displaying a negative SE on effort also have a negative SE on hours
Fehr & Goette (2005)	Shift and effort decision of bicycle messengers	Yes	Choose to work more shifts but exert less effort per shift	Reference dependent preferences	- no within day effort decision - hours vs. shift decision (hours decision constrained by shift?)
Goette & Huffman (2005, 2006)	Within-day effort decision of bicycle messengers	Yes	Effort increases early in the day but reduction of effort in later hours	Reference dependent preferences (2006: affective vs. cognitive system)	- no distinction between effort reduction during the day and quitting for the day - hours vs. shift decision?

Figure 2: Summary of studies on intertemporal labour supply

*wage increase anticipated or not