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Monopsony, Minimum Wages and Migration

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Abstract

We show in a monopsony model that in response to a small increase in migration employment will increase in both low productivity non-compliant firms who pay less than and in high productivity firms who pay more than the minimum wage, but will increase by proportionately more in minimum wage firms who are constrained by the labour supply curve. Using data from Thailand we provide evidence that increases in inward net migration are indeed associated with a proportionately greater increase in employment at than below the minimum wage.

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Introduction

It is well known in textbook monopsony models that if a minimum wage is introduced, there is a range of values for the minimum wage where employment will increase [See Borjas (1996) chapter 5 for example]. A straightforward implication of this result is that if a minimum wage is set in the range where employment increases, a small increase in migration will increase employment of workers employed at the minimum wage. If, in contrast, the minimum wage is above the range where employment is increasing, firms are on their labour demand curve and we have the standard competitive result that an increase in the minimum wage lowers employment while an increase in migration leaves employment unchanged for a binding minimum wage. Arguably, whether this result holds true more generally is of considerable importance as it identifies a channel through which low skill employment can increase in response to inward migration without lowering wages. However, to the best of our knowledge no other paper has pointed out or tested this implication of the monopsony model, although Hirsch and Jahn (2012) and Hotchkiss and Quispe-Agnoli investigate empirically whether migrants or undocumented workers respectively have different labour supply elasticities motivating the empirical test with an appeal to monopsony models.³ In this paper we thus explicitly explore whether employment of minimum wage workers may increase faster than other workers in response to an increase in migration using a monopsony model of the labour market, and substantiate our findings using empirical evidence for Thailand.

There is of course already a large literature looking at the employment effects of minimum wages, with some very prominent studies such as Card and Krueger (1995) finding either no negative employment effects or some small positive effects. Such studies often cite

³ For example Hirsch and Jahn (2012) suggest that when migrants enter a new labour market they face higher search costs which confers a greater degree of monopsony power on employers who hire migrants.

imperfectly competitive models, such as monopsony models, as a way of rationalising their results; see Card and Krueger (1995) or Giuliano (2013) for example. Such models of monopsony tend to use factors such as search frictions or turnover costs [see Manning (2003) or Dickens et al. (1999) for example] or firm specific preferences [see Bhaskar and To (1999) or Walsh (2003)] to motivate why firms may have monopsony power⁴. The degree of monopsony power in these frameworks often differs across firms [as in the model of Dickens et al (1999)] or worker types, so that generalising the model to allow for this heterogeneity is important⁵. In the theoretical framework employed here we analyse the impact of migration with a binding minimum wage in such a monopsony model with homogeneous firms and many different levels of worker ability. We show that if the firm faces the same relative supply curves for each ability group, the firm will be on the labour demand curve and the minimum wage will bind for the lowest ability workers for whom relative demand (marginal productivity) will be lowest. An increase in migration leaves employment unchanged for this group as in the competitive model. For higher ability groups where labour supply is less than the number of workers the firm wishes to hire⁶, the firm is constrained by the labour supply curve, and an increase in labour supply (migration) will increase employment of this group. Migration will also increase employment of ability groups for whom the minimum wage is not binding.

We then introduce non-compliance with the minimum wage into our model where workers are homogeneous and there is variation in firm productivity. Arguably, non-compliance is an important issue, particularly in many developing countries, including Thailand. Since the empirical evidence suggests non-compliance tends to be concentrated in

⁴ Arguably the increased mobility of workers and firms suggest that more traditional monopsony models where large employers dominate local labour markets by virtue of their size may be less important than in earlier times as suggested by Brown et al. (1982) for example.

⁵ The April 2010 edition of the Journal of Labor Economics was a special issue focussing on Monopsony in the Labor market. Ashenfelter et al (2010) summarises the papers in this volume. Many of the studies in the volume provide evidence of monopsony power for particular groups of workers, labour markets.

⁶ This is as in Figure 1.

small firms⁷, we employ a model with one skill group but where firm size, which is in consequence to a productivity parameter, determines whether the firm finds it profitable to be compliant with minimum wage rules or not. We show that while migration increases employment in non-compliant firms, the positive effect of migration on employment is proportionately higher in firms that are constrained by the minimum wage but where the labour supply constraint is binding. For firms that comply with the minimum wage but who are on the labour demand curve, migration leaves employment unchanged. One can thus conclude that the bigger the share of minimum wage employment that is accounted for by firms who are constrained by the labour supply constraint relative to the share in firms who are on the labour demand curve, the more likely it is that minimum wage employment will rise by proportionately more than employment in non-compliant firms.

There is also a large literature that analyses the labour market impact of migration [See Hanson (2010) for a review that concentrates on the literature in relation to the developing world]. Given the size of these flows and the widespread application of minimum wages that are binding, the predictions of the model presented here are shown to add a potentially important element to our understanding of how migration effects employment and wages in the host economy if they are shown to have empirical support. In seeking empirical evidence supportive of the predictions of our model it is of course important to note that there are fundamental difficulties in empirically testing the prediction that employment may increase in response to a minimum wage. More precisely, exogenous changes in the minimum wage in one market relative to another comparable tend to be rare. Indeed Card and Krueger spend a good deal of time convincing the reader that the natural experiment they examined, i.e., where the minimum wage increased in New Jersey but not in neighbouring Eastern Pennsylvania, did actually represent an exogenous change in the minimum wage.

⁷ See Strobl and Walsh (2003) for a discussion of non-compliance and the minimum wage.

Here we utilize rich labour market data for Thailand and, following Boustan et al (), use regional weather variation to construct arguably valid instruments for inter-regional migration in our econometric analysis. Our results indeed show that an increase in inward net migration is associated with an increase in employment of minimum wage workers and that this is proportionately greater than the increase in employment of workers paid less than the minimum wage.

Finally, one may want to note that Strobl and Walsh (2011) show that using a standard competitive model of the labour market, where firms choose a combination of the number of workers and hours, that the theory predicts that the change in the number of workers and total hours in response to an increase in the minimum wage is ambiguous. Testing the empirical prediction of our model that employment at the minimum wage and perhaps the share of minimum wage employment may increase in response to an increase in migration/labour supply can thus be viewed as an alternative test of the monopsony model.

The remainder of the paper is organized as follows. In the subsequent section we introduce our theoretical model. Section III describes our data set and provides some summary statistics. The econometric framework and its results are given in Section IV. Finally, concluding remarks are provided in the final section.

I. A monopsony model with heterogeneity in worker ability

As a starting point for our theoretical analysis we first illustrate the relevant result of a standard simple textbook monopsony model regarding the impact of minimum wages on employment graphically in Figure 1. As can be seen, in the absence of a minimum wage the monopsony solution is where the marginal cost of labour intersects the labour demand curve, where employment is l^m and the wage is w^m . If a minimum wage is imposed at $\bar{w}$ this

becomes the marginal cost of labour and employment increases to $\bar{l}$. Thus, if an increase in migration shifts the labour supply curve and marginal cost of labour to the right, employment increases by the vertical shift in the labour supply curve to $\bar{l}^1$. Below we investigate this aspect more generally in a monopsony model with homogenous firms and different levels of worker ability.

1.1: The model with many skill groups and full compliance

Each firm is at the end of a unit interval. There is a mass μ_i of each of m types of worker uniformly distributed along the interval, where each worker type has a different productivity characteristic and a zero reservation wage. The production function is: $y = F(L)$ Where the vector of workers of each type is: $L = (l_1 \dots l_m)$. We rank the worker types numerically so that the number of the lowest productivity workers in the firm is labelled l_1 , the second lowest: l_2 up to the number of the highest productivity workers l_m . For any group of workers k : $F_{l_k}(L) > 0$ and $F_{l_{k+1}}(L) < 0$. In line with the assumptions above we assume that $F_{l_k}(L) > F_{l_j}(L)$ if $k > j$. The transport costs associated with travelling a distance x to go to work is tx for all workers. All workers have a reservation wage of zero. This implies that a worker of type k who is within distance x^0 of the firm will be willing to work for firm i as long as the wage exceeds transport costs:

$$x^{0k} = \frac{w_k}{t} \quad (1)$$

The labour supply curve facing a firm for this labour type is:

$$l_k = \frac{\mu_k}{t} w_k \quad (2)$$

We assume that the supply parameter μ_k is the same for each worker type. We also assume that the firm must pay all workers within any skill group the same wage. That is they cannot discriminate. The measure of the labour force is: $M = \sum_{k=1}^m \mu_k$. Workers can fall in three different categories: firms (a) pay some workers more than the minimum wage, (b) pay some workers the minimum wage but are constrained by the labour supply constraint, (c) pay some workers the minimum wage but where these workers are not constrained by the labour supply constraint. We categorise the set of worker types in each of these three categories as: $\Omega_a, \Omega_b, \Omega_c$ respectively. We note that if a firm chooses an amount of any labour type such that: $l_k < \mu_k \frac{\bar{w}}{t}$, it can choose to either pay the minimum wage or pay the wage implied by the labour supply curve of that labour type, which is less than the minimum. However, if they pay less than the minimum, then there is a chance that they will be prosecuted for non-compliance and face a penalty. Initially we assume the penalty is large enough and enforcement technology is effective enough to ensure full compliance. Later we will deal with non-compliance in a model with a single skill group. Given these assumptions the profit function can be written

$$\pi_i = y - \sum_{k \in \Omega_c} w_k l_k - \sum_{k \in \Omega_b} \bar{w}_k \sum_{k \in \Omega_a} \bar{w}_k \quad (3)$$

We can examine how the firm chooses the number of workers in each of these three categories. If the firm chooses to pay more than the minimum wage to any worker type i , where type i workers are in category a , the firm is on the labour supply curve for this worker type and the first order condition for employment is:

$$F_{l_i} \left(\frac{\mu_i}{t} w \right) - 2w_i = 0 \quad w_i > \bar{w} \quad (4)$$

Alternatively the firm could pay the minimum wage, in which case the first order condition that would maximise employment depends on whether the labour supply constraint is binding on the firm in choosing the optimal number of workers to hire. If the labour supply constraint is binding for any worker type j who are in category b , the firm will choose the number of employees where:

$$F_{l_j}(L) - \bar{w} > 0 \quad l_j^* = \mu_j \frac{\bar{w}}{t} \quad (5)$$

This is the condition where the firm would like to hire more workers at the minimum wage, but given the labour supply constraint cannot without increasing the marginal cost of labour above the minimum wage. If the firm can hire as many workers as it wishes at the minimum wage for any worker type k who are in category c , then the first order condition which determines employment is:

$$F_{l_k}(l) - \bar{w} = 0 \quad l_k^* < \mu \frac{\bar{w}}{t} \quad (6)$$

We see immediately that if we are in an equilibrium with some workers in each of categories a, b and c , then the highest productivity workers will be in category a since employment is increasing in marginal productivity. We note from our earlier assumptions that marginal productivity is increasing in ability. We define k^* as the ability group below which the minimum wage is binding. One should note that it would not make sense for a firm to pay any ability group above k^* less than the minimum wage. For groups with ability less than that of group k^* there is a lower threshold ability group k^{**} , whereas for groups with higher ability than group k^{**} but lower ability than group k^* labour demand will be high enough so that at the minimum wage the firm will maximise profit according to equation (5). In this case the skill level and marginal product of labour is high enough to ensure that the firm will

hire all workers willing to work at the minimum wage but marginal productivity is not high enough to make the firm want to pay more than the minimum. For groups with ability less than that of group k^{**} the firm will maximise profit at the minimum wage according to equation (6). In other words, skill and marginal productivity are low enough so that if the firm pays the minimum wage the number of workers it wishes to hire is less than the number willing to work according to the labour supply curve.

Proposition One: *For any worker type k where the minimum wage is binding and where the labour supply constraint is binding on the firm at the minimum wage:*

- (a) *A small increase in the minimum wage will increase employment of that worker type at the firm.*
- (b) *A small increase in migration (the labour force) of group k will increase employment of that worker type at the firm.*

Proof: From equation (5) employment of worker type k is $l_k = \mu \frac{\bar{w}}{t}$. We see that this is increasing in the minimum wage and in the mass of type k workers

Proposition One depends on the fact that the labour supply of any worker group is independent of the labour supply of other groups. It shows that the result of the textbook monopsony model that a small increase in the minimum wage or migration will increase employment when the firm is constrained by the labour supply curve persists even when there are many ability groups, some of whom are paid more than the wage and some for whom the firm may not be bound by the labour supply constraint but pays the minimum wage. Of

course this is true only for a small change because a discrete change in any labour type may affect the thresholds k^* and k^{**} and potentially change employment.

Proposition Two: *For any worker type k where the minimum wage is binding and where the labour supply constraint is not binding on the firm at the minimum wage, an increase in migration of type k workers, or of any other group in the set Ω_b , leaves employment unchanged.*

Proof: The employment vector for each of the m worker types is determined by the solution of m simultaneous equations. For each worker type in category a employment is determined by the solution to equation (4). For each worker type in category b employment is given by solving equation (5), and for each worker type in category c employment is given by solving equation (6). When we write out these m equations we note that each one is independent of a small change in μ_k or a small change in the mass of any other worker type in category b .

Proposition Two shows that the result that when firms are on their labour demand curve employment will be unaffected by migration of more workers of that type, continues to hold irrespective of the ability distribution.

I.2: Non-compliance with the minimum wage:

The previous section showed that an increase in migration will increase employment of worker groups that are constrained by the labour supply curve but leave employment unchanged for worker groups that are not constrained by labour supply. For many countries,

and developing countries in particular, non-compliance with the minimum wage is widespread. This complicates the model since low skill migrants who cannot find minimum wage employment may enter uncovered employment. In this section we use a framework with homogeneous workers but heterogeneity across firm productivity that generates variation in firm size. This allows the model to mimic the stylised fact that compliance with the minimum wage tends to fall sharply in larger firms. Productivity will affect the firm's size and in turn the firm's choice between compliance and non-compliance with the minimum wage. We will look at four types of firms respectively: (1) firms that do not comply with the minimum wage, (2) firms that pay more than the minimum wage, (3) firms that pay the minimum wage and are on their labour demand curve, and (4) firms that pay the minimum wage but are constrained by the labour supply curve.

We show that in a monopsony setting with some non-compliant firms, an increase in migration will expand employment in non-compliant firms and in firms who pay more than the minimum wage. Employment is unchanged in firms who pay the minimum wage and who are on the labour demand curve but increasing in compliant firms who are constrained by the labour supply curve. We will show though that the proportionate increase in employment is greatest in the supply constrained minimum wage firms.

We assume that the probability of being caught not complying with the minimum wage is an increasing function of firm size⁸:

$$q(l) = q\left(\frac{\mu}{t} w\right) \quad \text{where } q_l > 0 \text{ and } q_{ll} > 0 \quad (7)$$

The functional form of this equation possibly depends on institutional features that vary across different labour markets. We assume here that in countries where non-compliance is

⁸ Firms paying less than the minimum wage will be on the labour supply curve.

prevalent the ability of regulators to identify small firms who are non-compliant may be limited. The ability of a regulator to effectively impose penalties may also vary with firm size. In theory a large enough penalty will ensure full compliance as long as there is some possibility of being caught. In practice the size of the penalty that can be collected may be limited by the wealth of the employer (which is possibly positively related to firm size) or social norms etc. We assume that the penalty that firms pay if caught paying less than the minimum wage is the amount of the wage bill less than the minimum wage plus a fixed per worker penalty A . :

$$(\bar{w} - w + A)l = (\bar{w} - w + A) \frac{\mu}{t} w \quad (8)$$

For a firm that is not-complying with the minimum wage, the profit function is:

$$\pi = PF\left(\frac{\mu}{t}w\right) - \frac{\mu}{t}w^2 - q\left(\frac{\mu}{t}w\right)[(\bar{w} - w + A)\frac{\mu}{t}w] \quad w < \bar{w} \quad (9)$$

The first and second order conditions and cross partial terms are respectively:

$$\pi_w = \frac{\mu}{t} \left\{ PF_l\left(\frac{\mu}{t}w\right) - 2w[1 - q\left(\frac{\mu}{t}w\right)] - q_l\left(\frac{\mu}{t}w\right)[(\bar{w} - w + A)\frac{\mu}{t}w] - q\left(\frac{\mu}{t}w\right)(\bar{w} + A) \right\} \quad (10)$$

$$\pi_{ww} = \frac{\mu}{t} \left\{ \frac{\mu}{t} PF_{ll} - 2(1 - q) + 4wq_l \frac{\mu}{t} - q_{ll} \frac{\mu}{t} [(\bar{w} - w + A)\frac{\mu}{t}w] - 2\frac{\mu}{t} q_l(\bar{w} + A) \right\} \quad (11)$$

$$\pi_{w\mu} = \frac{\pi_w t}{\mu} + \frac{\mu}{t} \frac{w}{t} \left\{ PF_{ll} + 3q_l w - q_{ll} [(\bar{w} - w + A)\frac{\mu}{t}w] - 2q_l(\bar{w} + A) \right\} \quad (12)$$

We assume that $q_{ll} > 0$ so that the probability that a firm is caught paying less than the minimum wage is increasing in employment but that the second derivative is also positive. Even with this it is not clear that the second derivative in (11) is negative, however we can

show that since $w < \bar{w}$, a sufficient condition for (11) to be negative is that the per worker fixed penalty for non-compliance with the minimum wage is more than the minimum wage:

$$A > \bar{w} > w \quad (13)$$

Totally differentiating the change in the wage from a small change in migration/labour supply is:

$$\frac{dw}{d\mu} = \frac{-\pi_{w\mu}}{\pi_{ww}} \quad (14)$$

Since $\pi_w = 0$ at the optimum and given that we can say that equation (12) is negative if inequality (13) is true, this implies from equation (14) that an increase in migration would lower the wage paid by non-compliant firms. Since these firms are on the labour supply curve the change in employment and proportionate change in employment from a change in migration are:

$$\frac{dl}{d\mu} = \frac{\partial l}{\partial \mu} + \frac{dw}{d\mu} \frac{\partial l}{\partial w} = \frac{w}{t} + \frac{\mu}{t} \frac{dw}{d\mu} \quad \frac{dl}{d\mu} \frac{1}{l} = \frac{1}{\mu} \left(1 + \frac{dw}{d\mu} \frac{\mu}{w}\right) \quad (15)$$

We note from equation (15) that if $\frac{dw}{d\mu} \frac{\mu}{w} < -1$ then employment could fall in response to an increase in migration in non-compliant firms. We show in the Appendix that this will not be the case.

For a firm paying more than the minimum wage the profit function is:

$$\pi = PF\left(\frac{\mu}{t} w\right) - \frac{\mu}{t} w^2 \quad w > \bar{w} \quad (16)$$

The first order condition is:

$$PF_l(\frac{\mu}{t}w)\frac{\mu}{t}-2\frac{\mu}{t}w=0 \quad (17)$$

It is straightforward to see that the second order condition is negative. Totally differentiating the first order condition we see that the change in wage from a change in migration is:

$$\frac{dw}{d\mu} = -\frac{PF_{ll}\frac{\mu w}{t^2}}{PF_{ll}(\frac{\mu}{t})^2-2\frac{\mu}{t}} < 0 \quad (18)$$

The change in employment from a change in migration is given by equation (15) above.

For a firm that pays the minimum wage the profit function is:

$$\pi = PF(l) - \bar{w}l \quad w = \bar{w} \quad (19)$$

If productivity is low enough so that the firm wishes to hire fewer workers than are supplied at the minimum wage, then the firm is on the labour demand curve and the first order condition is:

$$\pi_l = PF_l(l) - \bar{w} = 0 \quad l < \frac{w\mu}{t} \quad (20)$$

In this case a small change in migration has no effect on firm level employment since employment is constrained by the labour demand curve as was the case in Proposition two above.

If the firm wishes to hire more workers than are supplied at the minimum wage the firms optimising condition is:

$$\pi_l = PF_l(l) - \bar{w} > 0 \quad l = \frac{w\mu}{t} \quad (21)$$

In other words, the last worker hired has a higher value of marginal product than marginal cost, but the firm is constrained by the labour supply curve. As in *Proposition One* above the change in employment and proportionate change in employment from a small change in migration are:

$$\frac{dl}{d\mu} = \frac{\bar{w}}{t} \quad \frac{dl}{d\mu} \frac{1}{l} = \frac{1}{\mu} \quad (22)$$

We see, comparing (22) and (15) that since $w < \bar{w}$ and $\frac{dw}{d\mu} < 0$ in equation (15), for non-compliant firms that the change and percentage change in employment from a change in migration are positive but lower than for a minimum wage firm which is constrained by the labour supply curve. In contrast, for smaller minimum wage firms who are on the labour demand curve employment is unaffected by an increase in migration while it increases for non-compliant firms.

Next we illustrate that smaller low productivity firms will be non-compliant. The difference between profit of a compliant minimum wage firm and a non-compliant firm is given by the difference between equations (19) and (9):

$$\bar{\pi} - \pi = P[F(\bar{l}) - F(\frac{\mu}{t}w)] + \frac{\mu}{t}w^2 + q(\frac{\mu}{t}w)[(\bar{w} - w + A)\frac{\mu}{t}w] - \bar{w}\bar{l} \quad (23)$$

The optimal choice of employment for a minimum wage firm satisfies equation (20) and is $\bar{l}$ while w is the optimal wage chosen by the non-compliant firm according to equation (10). The derivative of the profit differential given in equation (23) with respect to productivity is:

$$\begin{aligned} \frac{d(\bar{\pi} - \pi)}{dP} = & [F(\bar{l}) - F(\frac{\mu}{t}w)] + F_l(\cdot) \frac{\partial \bar{l}}{\partial P} + \frac{\partial w}{\partial P} \{F_l(\cdot) \frac{\mu}{t} + 2w \frac{\mu}{t} + \\ & q_l(\cdot) \frac{\mu}{t} [(\bar{w} - w + A) \frac{\mu}{t} w] + q(\cdot) \frac{\mu}{t} (\bar{w} - 2w + A)\} > 0 \end{aligned} \quad (24)$$

Since $[F(\bar{l}) - F(\frac{\mu}{t}w)] > 0$, $\frac{\partial \bar{l}}{\partial P} > 0$ and $\frac{\partial w}{\partial P} > 0$ it is straightforward to see that the difference in profits between compliant and non-compliant firms is increasing in productivity. Thus, as long as there is an equilibrium with some non-compliant and some compliant firms, the non-compliant firms will be small low productivity firms.

We define the number of workers employed at the minimum wage in firms that are on their labour demand curve or constrained by the labour supply curve respectively as: $\bar{E}^d$ and $\bar{E}^s$, and total minimum wage employment as: $\bar{E} = \bar{E}^d + \bar{E}^s$. We define the number of workers employed in non-compliant firms as: E^n . Given this the rate of compliance with the minimum wage is: $c = \frac{\bar{E}}{E^n + \bar{E}}$ and the percentage change in compliance is:

$$\frac{dc}{c} = \frac{d(\frac{\bar{E}}{E^n + \bar{E}})}{(\frac{\bar{E}}{E^n + \bar{E}})} = \frac{d\bar{E}(E^n + \bar{E}) - dE^n \bar{E} - d\bar{E} \bar{E}}{\bar{E}(E^n + \bar{E})} = \frac{d\bar{E}E^n - dE^n \bar{E}}{E^n(E^n + \bar{E})} = c[\frac{d\bar{E}}{\bar{E}} - \frac{dE^n}{E^n}] \quad (25)$$

An increase in migration will thus only increase compliance if the percentage increase in minimum wage employment is greater than the percentage increase in non-compliant employment as we expect. This means that if we observe an increase in compliance in

response to a minimum wage that employment of minimum wage workers is increasing unless employment in non-compliant firms falls in response to an increase in inward migration. The likelihood that employment of non-compliant workers would fall in response to an increase in labour supply seems intuitively implausible in most economic models and as we show in the Appendix it cannot happen in the model we present here. We next investigate whether these predictions are consistent with the empirical evidence using data from the Thai labour market.

II. Data and Sample Selection

II.1: Minimum Wages in Thailand

A daily minimum wage is legally enforced in Thailand under the Labour Protection Act (1998).⁹ Under this act the National Wage Committee comprised of employee and employer representatives and representatives of the ministry for labour periodically makes recommendations to the government concerning adjustments to the minimum wage rate. In addition, tripartite provincial committees can review wage situations in their respective areas and recommend that a minimum wage that is higher than the basic rate be set for certain provinces. Provincial rates cannot be below the national minimum rate. Agricultural workers and domestic workers are not covered by the minimum wage legislation. Employers who run private schools are also excluded from the Labour Protection Act, as are workers in central, provincial and local administration and state enterprises governed by the Law on State Enterprises. The labour protection act specifies an enforcement regime where labour inspectors are entitled to enter workplaces during work hours and inspect labour records etc. Penalties, including fines and terms of imprisonment, may be applied to employers found not to be in compliance. How strict the regime is in practice is difficult to know, but, as we will

⁹ The first Thai minimum wage was enforced in 1973.

see below, there appears to be widespread non-compliance with the minimum wage amongst covered workers.¹⁰

II.2: Thai Labour Force Survey

Our main data source is the Thai Labour Force Survey (TLFS), where we have access to the surveys conducted between 1991 and 2000. The TLFS is conducted several times a year, with increasing frequency in recent years. We have access to data for the February and August surveys for each year, where August is the peak of the agricultural season and when labour markets are much more buoyant with significant internal migration as workers return to rural areas for harvesting, whereas February clearly represents the off-peak season of agriculture in Thailand. The survey is a large cross-section; for example, the February 2000 survey has 164,636 observations. In sum, the complete data consists of twenty waves with a total of 2,951,839 observations.

The survey contains a wide variety of questions on location, employment status, and job characteristics, as well as demographic characteristics. Data on earnings asks workers if they are paid hourly, daily, weekly, or monthly and what the rate of pay is for the relevant category. We use the TLFS to construct two data sets: (i) minimum and potentially minimum wage relevant males, and (ii) male migration flows between provinces.¹¹

II.3 Daily Wage Male Sample

For the main regression analysis, where we investigate how migration flows affect the probability of being employed in a minimum wage compliant job for non-migrant (incumbent) workers, we work with a reduced sample of males from the data set. Firstly, we

¹⁰ The ILO Travail database provides more detail on these issues http://www.ilo.org/dyn/travail/travmain.sectionReport1?p_lang=en&p_structure=1&p_sc_id=23&p_countries=TH

¹¹ There are 72 provinces in Thailand.

reduce the sample to non-migrant men aged 15-64 who were not attending school at the moment of the survey and who work 95 hours or less a week in the private sector.¹² We also drop observations of self-employed, government or public service workers as well as workers who are in unpaid jobs or in sectors not covered by the minimum wage¹³. Since we are interested in identifying those workers that are paid the minimum wage or potentially could be, we attempted to build a sample that was as relevant as possible to this group. In this regard we only include daily wage workers since minimum wages are defined in terms of daily values. This allowed us to avoid potential measurement error for monthly and yearly paid workers where we would have had to estimate their daily wage value by dividing income by the reported number of days worked last week. About 52 per cent of male workers in Thailand are paid a daily wage as remuneration.

To limit our sample further to those for which the minimum wage would be relevant, we reduced our sample to those whose daily wage was equal to their province's minimum wage or below it. In order to allow for some measurement error we defined those as compliant to the minimum wage as those that were paid within 1 per cent of its official value given in any year, although we also as a robustness check use a sample that allows for a larger error band of 5 per cent. All those that are paid below this minimum wage band are considered non-compliant. To demonstrate that the minimum wages were indeed 'binding' for a substantial group of workers and that our measurement error band is reasonable we divided an individual's wage by the relevant minimum wage and depict the distribution of this ratio for a range of values from 0.5 to 1.5, with vertical lines illustrating the 0.99 and 1.01 bands around the minimum wage in Figure 2. As can be seen, within this range nearly 40 per cent of observations are within the 1 per cent bands around the minimum wage, indicating that daily

¹² We focus on males to avoid the sample selection issues associated with females who have lower participation rates.

¹³ Using detailed occupation codes from the data uncovered workers are those whose industry/occupation code indicates that they work in private households, are relations/servants living in the house of their employer or work in Agriculture or government. While teachers in private schools are not covered we could not exclude this group since we can't identify them explicitly according to sectoral and occupational codes of our data.

minimum wages are indeed meaningful and potentially binding in Thailand. In contrast, we also depict the same graph but for those private sector workers that have no minimum wage in Figure 3. For this sample, in stark contrast, there is no peak at the minimum wage and the general distribution of relative wages is very different than for the compliant sectors.

Our final sample thus consists of minimum wage compliant and non-compliant male daily workers, providing a total of 29,366 observations after dropping all observations for which there were missing values for any variables we used in our empirical analysis. As can be seen from the summary statistics in Table 1, in our sample 82 per cent are paid below the minimum wage. As is commonly found in developing countries, the degree of non-compliance falls with firm size. The average wage in our sample is 102 baht per day, while about 82 per cent of workers are low-skilled workers. High-skilled persons are those with an educational level beyond the secondary level and low skill secondary education or less.

II.4 Migration Flow Rates

In terms of constructing migration flows, importantly, in addition to providing the name of the province where they live, individuals in the survey answer the following question: “How long have you been living regularly in this village/ municipality?” In this regard, respondents can choose among the options: (a) from less than a year, (b) one year, two years, (c) up until nine, or (d) more than nine years. We exclude people who move into the same province and calculate the number of recent arrivals as those who answer less than or equal to one year. This number corresponds to 124,185 males and represents 52.4% of total movers to new provinces.¹⁴ We use this subsample of movers to compute the male inflow rates across provinces. To calculate outflow rates we utilize the question “Which is the previous province of your residence before moving here?”, which allows us to define the province of origin and

¹⁴ Note that the category of movers within provinces represents 29% of all movers and that 49.4% of the sample of movers from this category moved one year ago at most.

the destination province of all movers. From these questions we then calculate male inflow, outflow and net migration rates for each province. Importantly one should note that our migration rates are constructed from all male migrant flows (and not just the reduced daily wage sample), although we do also experiment with using skilled and unskilled migration flows when examining these specific groups. We provide summary statistics of our migration flow rates in Table 1. Accordingly, the average inflow rate is 4.6 per cent, while the outflow is about 3.7 per cent¹⁵.

III. Econometric Analysis

III.1 Construction of Migration Rate Instruments

In order to construct instruments for migration we follow the methodology proposed by Boustan *et al.* (2010), which consists of predicting the total outflow (inflow) from a region induced by weather shocks, and then decomposing this outflow (inflow) into destination regions by estimating the role of geographic distances in determining inter regional flows. We then use both weather and distance to construct the predicted inflow (outflow). More specifically, for the case of migration inflow this first involves regressing total outflow rates of each region on a set of climate determinants:

$$O-rate_{i,t-1 \rightarrow t} = \alpha + \delta' Z_{i,t-1} + \varepsilon_{i,t} \quad (26)$$

where $O-rate_{i,t-1 \rightarrow t}$ is the outflow rate from source region i over time period $t-1$ to t , Z is a vector of climate specific indicators, and ε is an error term. Using the estimated coefficients from (26) the predicted flow of migrants leaving each region i , $\tilde{O}_{i,t-1 \rightarrow t}$, is then just equal to the predicted outflow rate $\bar{O}-rate_{i,t-1 \rightarrow t}$, times the population at $t-1$.

$$\tilde{O}_{i,t-1 \rightarrow t} = \bar{O}-rate_{i,t-1 \rightarrow t} * Population_{i,t-1} \quad (27)$$

¹⁵ The net flow of migrants is close to zero at 0.009 as we expect since one provinces inflow is another's outflow summing to zero.

One then separately for each sending area i regresses the actual set of destination specific outflow rates to each destination region j on their relative distances and it's squared and cubic value¹⁶:

$$O-rate_{ij,t-1 \rightarrow t} = \alpha_i + \theta_i Distance_{ij} + \theta_i Distance_{ij}^2 + \theta_i Distance_{ij}^3 + \mu_{i,t} \quad (28)$$

The instrument for in-migration to region j , $\bar{I}_{j,t-1 \rightarrow t}$, is then just the sum of the predicted number of migrants over all areas $i \neq j$, $\bar{O}-rate_{ij,t-1 \rightarrow t}$ expected to settle in region j :

$$\bar{I}_{j,t-1 \rightarrow t} = \sum_{i=1, \dots, n (i \neq j)} \tilde{O}_{i,t-1 \rightarrow t} * \bar{O}-rate_{ij,t-1 \rightarrow t} \quad (29)$$

One can then in a similar manner construct predicted outflow from area j by predicting the in-migration rates to each receiving area i using climatic determinants, using these rates to predict the number of inflowing migrants into i , and then constructed predicted outflow migrants by multiplying this figure by the distance and its non-linear terms estimated inflowing rates between regions i and j ($i \neq j$).

In order to estimate (26), as well as its analogous specifications for the in-migration, we use for the vector Z a number of measures that capture weather conditions in a region. In order to identify periods of extreme wetness and dryness in regions we first calculated the local standardized precipitation index (SPI), which has been argued to be particularly good at capturing the cumulative effect of high and low patterns of rainfall over time in a chosen locality, from the mean monthly precipitation values within our regions as calculated from the IPCC data set.¹⁷ Following McKee et al. (1993) we then define a monthly extremely dry (wet) event as starting when the SPI reaches an intensity of -2.0 (2.0) or less (more) and as

¹⁶ One should note that Boustan *et al.* (2010) regress these rates only on distance and its squared value. For the case of Thailand we found that including its cubic value substantially increased the specification's fit.

¹⁷ The calculation of the SPI is based on modeling the probability distribution of precipitation as derived from long term records by fitting these to a gamma distribution via maximum likelihood. An important component in this regard is the chosen time scale. Since we are interested in cropland productivity and soil moisture conditions are known to respond to precipitation anomalies over a relatively short time period, we use a 12 month scale.

See <http://www.drought.unl.edu/whatis/indices.htm>.

ending once the index become positive (negative) again. For each time period we then calculate the number of months of extreme dryness (wetness). The corresponding constructed variables are DRY and WET, respectively. To capture the effect of temperature, in particular with respect to its importance for agriculture, we construct a measure of reference evapotranspiration (ET) to represent the evaporative demand of the air within a basin from temperature data following Hargreaves and Samani (1985). Since the effects of rainfall shortages and abundance on local agriculture are likely to some extent to depend on the local evaporative demand, we also allow for interactions between ET and WET and DRY. To construct all these climatic factors at the regional level we resort to information from the Inter-Governmental Panel on Climate Change (IPCC) climatic data set, which provides monthly precipitation and temperature measures across the globe at the 0.5 degree level over the entire 20th century. We use these to calculate out time varying averages within provinces.

The results of estimating (26) for the semi-annual regional out- and in-migration rates, controlling for regional specific fixed effects and region common time specific factors are given in Table 2. Moreover, we calculate Driscoll and Kray (1998) standard errors corrected for spatial correlation throughout. As can be seen, for both of inflow and outflow rates, the set of climatic variables are almost all significant, producing highly significant F-tests of joint significance. Examining the individual factors, one finds that for the precipitation related factors the signs meet a priori expectations. More specifically, one finds that extremely dry as well as extremely wet weather, indicative of drought and flood like conditions, respectively, act to increase overall outflow from regions. Moreover, the negative impact of rainfall shortage is further exacerbated by a high evapotranspirative demand of the air. Somewhat surprisingly, the direct effect of evapotranspiration is to reduce outflow from a region, although in absolute terms this impact is small. For the inflow rate, one finds that extremely wet periods tend to reduce the inflow rate, while droughts have no significant effect.

Furthermore, a high evapotranspirative demand of the air tends to reduce the effect of the latter. Surprisingly one finds that this demand on its own acts to increase person flowing to the region, although again not substantially so. To construct the predicted inward and outward migration rates by sub-group we proceeded in similar manner as for the overall sample, except restricting construction via (26) through (29) to the sub-sample in question. We report the estimation for (26) for the outflow and inflow rates in Table 2, respectively. As can be seen, for the outflow rate all climatic variables are significant, where the signs are in congruence with the overall sample. Unsurprisingly the joint F-tests attests to their power as predictive factors. For the inflow rates, the majority of coefficients are significant and similar to those from the overall sample. Similarly, the F-test statistics provide evidence of their predictive power.

In terms of estimating (28), since this involves estimating different specifications for each region, we only provide a brief outline of the results. One may want to first note that since our distance measures do not vary over time, our estimated specification in (28) does not control for region specific effects, but does include a set of time dummies to control for common region time specific factors determining the migration flows. We used Driscoll and Kray (1998) standard errors corrected for spatial correlation as we did for (26). For each region specific regression, we, after estimating the parameters on distance conducted an F-test of the null hypothesis that these were jointly zero. In the case of out-migration rates for only 4 regions, while in the case of in-migration rates for only 6 could the null hypothesis not be rejected. As with the overall sample the F-test of the distance variables suggested strong predictive power in almost all cases for the estimation of (28) for subgroups.

III.2 Non-Compliance and Net Migration

We turn to examining how migration flows affect the probability of workers daily wage being minimum wage compliant, controlling for other factors. As other control variables we

include all relevant variables as available from the TLFS. More specifically, in all specifications we include age and its squared value, hours and hours squared, 3 marital status dummies, 12 educational category dummies, 9 occupation dummies, 9 industry dummies, 72 province dummies, 20 wave dummies, and 7 employer size dummies. The results of a probit model including the non-instrumented net inflow rate of migrants for the total daily wage sample is shown in the first column of Table 3. Accordingly, the net inflow rate of migrants has no significant effect on the probability of working in a minimum wage non-compliant job, where the coefficient is converted to the marginal effect.

We next instrument for the net inflow rate of migration with the instruments described above, as depicted in the second column of Table 3. Examining the first stage it is apparent that our instruments, the constructed migration inflow and outflow rates significantly predict net migration. As a matter of fact, a Wald test suggests that these are strong predictors of the observed net migration rate. Examining the coefficient on (instrumented) net migration rate one discovers that there is now a positive and significant effect on the probability of non-compliance. This underlines the importance of taking account of the likely endogeneity of migration in local labour markets. The observed marginal effect suggests that a 10 percentage point increase in net migration increases the probability of working in a non-compliant job by 1.2 percentage points.

In the third column we reduce our sample to low skilled workers. Again, the first stage results that the constructed instruments are reasonable predictors of the rate of net migration. The observed (instrumented) marginal effect is slight larger than for the overall sample, where a 10 percentage point raises the probability of not being paid the minimum wage by 1.5 percentage points.

Thus far we have used a fairly conservative error band around the minimum wage. In the last two columns we thus, as a robustness check, widen this band in that any daily wages

within 5 per cent of the minimum wage would be considered as compliant. As can be seen, widening the band does not alter our results qualitatively, but as might be expected reduces the estimated effect by 27 and 32 per cent for the total and low skilled sample, respectively.

IV. Conclusion

In this paper used a monopsony model where workers are homogenous and there is variation in firm productivity to show that that in response to a small increase in migration employment will increase in both low productivity non-compliant firms who pay less than the minimum wage, as well as in high productivity firms who pay more than the minimum wage. In contrast, employed increases by proportionately more in minimum wage firms who are constrained by the labour supply curve. Using data from Thailand we provide evidence that increases in inward net migration are indeed associated with a proportionately greater increase in employment at than below the minimum wage.

It might be argued that the importance of the results we present here may be of limited importance given that in many developing countries in particular, non-compliance with the minimum wage is widespread. However, summarising the evidence on minimum wage from developing countries Freeman (2010) suggests that

“...in many developing countries, minimum wages raise the pay of low-paid workers in the formal sector adequately to produce spikes in the distribution of earnings and that changes in the minimum change the wages for low-paid covered groups.”

That is even for countries with substantial non-compliance, as is the case for Thailand as we demonstrated here, in many such countries minimum wages are binding for a substantial groups of workers. Given that most countries have binding minimum wages and the large and increasing scale of labour flows, the model in this paper may help us provide a more complete understanding of the impact of migration flows on the host economy

The results in the paper also provide evidence supporting a non-competitive model of the labour market. Clearly this also has important implications for policy. For example Freeman (2010) suggests that an overly simplistic theoretical framework led many international organisations to give damaging advice to developing countries with an excessive focus on deregulation of the labour market, while Manning (2003) spells out the implications of the Monopsony model of the labour market over a wide range of issues.

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Figure 1: An increase in migration with a modest minimum wage

$$l^m \quad \bar{l} \quad \bar{l}^{\dagger}$$

Figure 2: Distribution of Salary/Minimum Wage – Compliant Sectors

Figure 3: Distribution of Salary/Minimum Wage – Non-Compliant Sectors

Table 1: Summary Statistics

Variable	Mean	Standard Deviation
<i>Non-Compliance:</i>		
<i>All Firms</i>	0.820	0.384
<i>??? employees</i>	0.398	0.499
<i>??? employees</i>	0.318	0.465
<i>??? employees</i>	0.313	0.463
<i>??? employees</i>	0.290	0.454
<i>??? employees</i>	0.259	0.438
<i>??? employees</i>	0.162	0.368
<i>??? employees</i>	0.081	0.272
<i>Salary:</i>	101.76	26.04
<i>Low-skilled:</i>	0.823	0.381
<i>Inflow Rate:</i>	0.046	0.030
<i>Outflow Rate:</i>	0.037	0.047
<i>NetFlow Rate:</i>	0.009	0.055

Table 2: The Effect of Weather on Inflow and Outflow Rates

	(1)	(2)	(3)	(4)
Dep. Variable:	Inflow	Inflow	Outflow	Outflow
DRY	-0.000417** (0.000153)	-0.000562** (0.000129)	0.00142* (0.000625)	0.00166* (0.000648)
WET	-0.000891* (0.000366)	-0.000797* (0.000325)	0.00235** (0.000709)	0.00231** (0.000692)
EVAPO	0.000636** (0.000182)	0.000613** (0.000163)	-0.000227** (7.61e-05)	-0.000262** (8.85e-05)
EVAPO*WET	-8.68e-06 (6.42e-06)	-5.18e-06 (5.34e-06)	2.75e-05** (7.25e-06)	2.54e-05** (7.64e-06)
EVAPO*DRY	-9.25e-06 (1.10e-05)	-9.87e-06 (7.63e-06)	1.88e-05* (7.68e-06)	2.14e-05* (9.34e-06)
Sample	All	Low-Skilled	All	Low-Skilled
Observations	1,440	1,440	1,440	1,440
Provinces	72	72	72	72
F-test	18.15**	31.16**	9.028**	8.172**

Notes: (i) Driscoll and Kray (1998) standard errors corrected for spatial and autocorrelation in parentheses; (ii) ** and * are 1 and 5 per cent significance levels; (iii) year and binannual dummies included but not reported; (iv) F-test is test of joint significance of the climatic variables.

Table 3: Non-Compliance and Net Migration

	(1)	(2)	(3)	(4)	(5)
Netflow Rate	-0.106 (0.078)	-12.424** (3.467)	-15.261** (3.915)	-8.651** (3.219)	-10.358** (4.065)
First Stage :					
Inflow Rate	---	14.523* (7.253)	8.878** (3.620)	14.356* (7.16)	8.500* (3.863)
Outflow Rate	---	-26.215** (7.735)	-13.545** (3.518)	-27.884** (7.935)	-14.005** (3.677)
Sample :	All	All	Low Skilled	All	Low Skilled
Obs. :	29366	29366	24176	33845	27883
Wald-statistic	---	9.31**	11.58**	5.61**	5.54**

Notes : (1) ** and * indicate 1 and 5 per cent significance levels; (2) The coefficient on the net migration rate is the marginal effect; (3) The Wald-statistic is a joint test of the significance of the instruments in the first stage; (4) Control variables include age, age squared, hours, hours squared, 4 marital status dummies, 12 education dummies, 9 industry dummies, 9 occupation dummies, 7 firm employer size dummies, 72 province dummies, and 20 wave dummies.

Appendix

In this Appendix we show that in response to a change in migration the percentage fall in wages at a non-compliant firm will be less than unity: $-\frac{dw}{d\mu} \frac{\mu}{w} < 1$. This means that the proportionate change in employment at a non-compliant firm given in equation (15) will be positive but less than the proportionate change in a supply constrained compliant firm given in equation (22).

A non-compliant firm could opt to hire the same number of workers that they hire in equilibrium, but pay them the minimum wage and avoid the possibility of detection. Since non-compliant firms choose not to do this it must be that the profit of being non-compliant is higher than the profit of hiring the same number of workers at the minimum wage. We denote the wage paid by a non-compliant firm in equilibrium as: w^n . Equation (9) gives the profit earned by a non-compliant firm paying this wage. This is greater than deviating to the minimum wage (in which case the probability of detection q is zero) if the following condition holds:

$$\begin{aligned} \pi &= PF\left(\frac{\mu}{t} w^n\right) - \frac{\mu}{t} w^{n2} - q\left(\frac{\mu}{t} w^n\right)[(\bar{w} - w^n + A)\frac{\mu}{t} w^n] > PF\left(\frac{\mu}{t} w^n\right) - \frac{\mu}{t} w^n \bar{w} \\ \text{or} \\ \frac{\bar{w} - w^n}{(\bar{w} - w^n + A)} &> q\left(\frac{\mu}{t} w^n\right) \end{aligned} \quad (30)$$

Since we assume that $A > \bar{w} > w$ in equation (13) and $\bar{w} > w^n$ by the definition of non-compliance, equation (26) implies that if a firm chooses to be non-compliant:

$$q\left(\frac{\mu}{t} w^n\right) < \frac{1}{2} \quad (31)$$

and second order conditions and cross partial terms are respectively:

$$\pi_{ww} = \frac{\mu}{t} \left\{ \frac{\mu}{t} PF_{ll} - 2(1-q) + 4wq_l \frac{\mu}{t} - q_{ll} \frac{\mu}{t} [(\bar{w} - w + A) \frac{\mu}{t} w] - 2 \frac{\mu}{t} q_l (\bar{w} + A) \right\} \quad (32)$$

$$\pi_{w\mu} = \frac{\pi_w t}{\mu} + \frac{\mu}{t} \frac{w}{t} \{ PF_{ll} + 3q_l w - q_{ll} [(\bar{w} - w + A) \frac{\mu}{t} w] - 2q_l (\bar{w} + A) \}$$

Using equations (11) and (12) in equation (14) and noting that $t \frac{\pi_w t}{\mu} = 0$ if the non-compliant

firm is optimising, the condition for $-\frac{dw}{d\mu} \frac{\mu}{w} < 1$ is

$$\begin{aligned} -\frac{dw}{d\mu} \frac{\mu}{w} &= -\frac{\pi_{w\mu} \frac{\mu}{w}}{\pi_{ww} \frac{\mu}{w}} = -\frac{PF_{ll} + 3q_l w - q_{ll} [(\bar{w} - w + A) \frac{\mu}{t} w] - 2q_l (\bar{w} + A)}{PF_{ll} - 2(1-q) \frac{t}{\mu} + 4wq_l - q_{ll} [(\bar{w} - w + A) \frac{\mu}{t} w] - 2q_l (\bar{w} + A)} \\ &= -\frac{X}{X - 2(1-q) \frac{t}{\mu} + wq_l} = -\frac{X}{X - \frac{w}{l} [2(1-q) - q_l l]} \end{aligned} \quad (33)$$

Where $X = PF_{ll} - q_{ll} [(\bar{w} - w + A) \frac{\mu}{t} w] - 2q_l (\bar{w} + A) < 0$. We note that as long as

$2(1-q) - q_l l < 0$ in equation (29) and noting that we showed earlier that: $\frac{dw}{d\mu} > 0$ then:

$$0 < -\frac{dw}{d\mu} \frac{\mu}{w} < 1 \quad (34)$$

Since $q(\frac{\mu}{t} w^n) < \frac{1}{2}$ from equation (27), it follows that: $2(1-q) > 1$. Since $q_l l$ is the change in

the probability of detection from a percentage change in employment and the probability must be less than unity, the change in the probability must be less than unity.