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Unemployment and Trade in Spatial Economics

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9.1 Introduction

It is well documented that trade policies have impacted labor markets substantially with the development of economic globalization. In recent years, President Trump has set some tough trade policies to improve the employment rate in the USA, greatly shocking the global market. During the last two decades, unemployment problems have become one of the major topics of theoretical research in spatial economics. This chapter seeks to review recent theoretical studies that link globalization to labor market outcomes, especially unemployment.

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Our review focuses on four mechanisms of unemployment which are commonly used in trade models: labor unions, search–matching unemployment, efficiency wages or fair wages, and minimum wages. Overall, the existence of unemployment is mainly driven by the imperfection of labor markets: the equilibrium wage rate is higher than the level of the labor market clearing. Workers in labor unions always claim a higher wage rate to maximize the union preferences. In models of efficiency wages and fair wages, firms pay their employees more than the market-clearing wage in order to increase their efficiency. In the Diamond–Mortensen–Pissarides search-matching model, bargaining is also a crucial process to solve the equilibrium. Furthermore, since matches between job seekers and vacancies are frictional, unemployed workers and unfilled vacancies coexist in the labor markets.

Regarding the unemployment–trade relationship, comparative advantages remain an important issue to be addressed in this field. Davidson et al. (1999) examine the effects of differential in job-searching technology across countries on trade pattern. They illustrate that the country with the more efficient search technology has a comparative advantage in production in a high-unemployment/high-vacancy sector. Trade raises the unemployment rate in the capital-abundant large country in this model. Brecher (1974) constructs a Heckscher–Ohlin (H-O) model in which the labor market is subject to an exogenously specified floor: the minimum wage. Davis (1998) proposes a trade model between a flexible wage country and a minimum-wage-bound country. Both of them show that trade can exacerbate unemployment. In general, such papers with comparative advantages mainly compare two extreme cases of free trade and autarky, neglecting the process of trade liberalization.[1]

In contrast, new trade theory (NTT) allows us to study the details of globalization when trade costs are intermediate. For example, incorporating fair wages into an NTT model, Egger and Kreickemeier (2012) are able to illustrate that unemployment and wage inequality are hump shaped with respect to trade freeness. Helpman and Itskhoki (2010) show

[1]To review more studies about the search process in trade with comparative advantages, see Davidson and Matusz (2004). In addition, Kreickemeier (2008) surveys theoretical studies on fair wages in trade models of comparative advantages.

that a lower trade cost raises the unemployment rate if and only if the differentiated good sector has higher labor market frictions. To clarify how trade barriers and trade policies change the labor market outcomes and unemployment, we mainly review the models of NTT in this chapter.

In light of the fact that exporters have a higher productivity than nonexporters, trade liberalization leads to intraindustry resource allocation, which also greatly impacts the labor market. The seminal paper of Melitz (2003) makes it possible to examine international trade with firm heterogeneity, starting the so-called new new trade theory. In this chapter, we also review how Melitz-type heterogeneity impacts the labor market and unemployment. Unfortunately, the researchers have not yet reached consensus. These studies do not provide a unified prediction for the unemployment–trade relationship. Opposite results are derived from different frameworks. Eckel and Egger (2009) incorporate firm-union bargaining into the model of Helpman et al. (2004) with multinational firms. They show that the unemployment rate is reduced by trade liberalization, since the highly productive multinational firms offer relatively low wages, fostering employment. Developing a model with matching frictional unemployment and firm heterogeneity, Felbermayr et al. (2011) demonstrate that the average productivity increases in an open economy, and firms search for workers more intensively. As a result, the unemployment rate decreases with globalization. On the other hand, considering the fair wage preference of workers, Egger and Kreickemeier (2009) and Egger and Kreickemeier (2012) predict the opposite result, that the unemployment rate is higher under trade liberalization. The intuition is that surviving firms have a higher average productivity in open trade, which leads to higher wages and lower employment.

A number of studies have examined how trade and the labor market imperfection affect the endogenous industrial location using frameworks of new economic geography (NEG). This literature demonstrates how disparities between national labor markets evolve with endogenous industrial agglomeration in trade. Agglomeration occurs if and only if migrants (or capital owners) can benefit from a larger market. Intuitively, workers in the core region are paid higher, and unemployment is lower there in general. Moreover, it was found that the industrial agglomeration force could be amplified by various factors when labor markets are frictional,

such as the bargaining power of workers (Picard and Toulemonde 2006) and fairness preferences (Egger and Seidel 2008).

The remaining parts of this chapter are organized as follows. Section 9.2 introduces the framework of labor unions and bargaining. In Sect. 9.3, we summarize theoretical studies focusing on search and matching frictions and unemployment. Section 9.4 presents the models of fair wages and efficiency wages. In Sect. 9.5, we review the studies related to minimum wages. Section 9.6 concludes.

9.2 Labor Unions

Let us start with the framework of labor unions (or collective bargaining), which is a standard way to introduce involuntary unemployment to international trade models. Due to the existence of bargaining between firms and labor unions, workers claim a wage rate that is higher than the level of labor market clearing.

In this section, we outline the basic model of a closed economy in Eckel and Egger (2009).[2] With a horizontally differentiated good x and a homogeneous good A, preferences of a consumer are given by a Cobb–Douglas utility function:

$$U = X^{\mu} A^{1-\mu}, \quad 0 < \mu < 1,$$

where

$$X = \left[\int_{v \in V} x(v)^{\frac{\sigma-1}{\sigma}} dv \right]^{\frac{\sigma}{\sigma-1}}$$

represents the composite good of the manufacturing sector, V is the set of available varieties of good x, and σ denotes the elasticity of substitution

[2]Blanchard and Giavazzi (2003) develop a one-country model with monopolistic competition in good markets and collective bargaining in labor markets. Mezzetti and Dinopoulos (1991) develop a partial equilibrium model of a domestic unionized firm and a foreign firm. They show that the way bargaining affects the labor employment depends on the form of union: wage oriented or employment oriented.

between any two varieties. Utility maximization determines the demand for variety v,

$$x(v) = \frac{\mu E}{P} p(v)^{-\sigma},$$

where $p(v)$ is the price of this variety, E denotes total consumption expenditures, and $P \equiv \int_{v \in V} p(v)^{1-\sigma} dv$ represents the price index.

Firms and unions face a three-stage game. At stage one, firms decide whether to enter the market according to their own productivity. If they decide to start production, they need to invest f units of good A to set up a plant. At stage two, there is wage bargaining at the firm level. Union activities are assumed to be restricted to a single firm. At stage three, firms choose an employment level and start production. The game is solved through backward induction.

Profit maximization yields the optimal price of a firm with productivity φ:

$$p(\varphi) = \frac{\sigma w(\varphi)}{(\sigma - 1)\varphi},$$

where $w(\varphi)$ is the wage paid by the firm. Then firm revenues and profits are derived as

$$r(\varphi) = \frac{\mu E}{P} p(\varphi)^{1-\sigma}, \quad \pi(\varphi) = \frac{\mu E}{\sigma P} p(\varphi)^{1-\sigma} - f.$$

The union preferences can be represented by a Stone–Geary utility function[3]:

$$W(\varphi) = l(\varphi)\left[w(\varphi) - \overline{w}\right],$$

where $l(\varphi)$ denotes the employment level of the firm. The average labor income is given by $\overline{w} = (1-u)\widetilde{w}$, where $\widetilde{w}$ is the average wage rate outside the firm and u represents the unemployment rate. Since firms

[3]Mezzetti and Dinopoulos (1991) and Zhao (1995, 1998) choose a more general form of union preferences and allow for different weights on employment and the excess wage.

share identical productivity, $w = \widetilde{w}$ holds in the equilibrium. Given $\overline{\pi} = -f$ as the firm's profit if the bargaining breaks down, and $\pi(\varphi)$ as that if an agreement is reached, the solution to the firm–union bargaining problem is determined by maximizing the Nash product:

$$\Omega = W(\varphi)^{\gamma}[\pi(\varphi) - \overline{\pi}]^{1-\gamma},$$

where $\gamma \in [0,1]$ is the bargaining power of the labor union. The solution of the maximizing problem is

$$w(\varphi) = \frac{\sigma - 1 + \gamma}{\sigma - 1}\overline{w}. \tag{9.1}$$

Hence, all firms pay the same wage rate in the equilibrium. Substituting $\overline{w} = (1-u)w$ into (9.1), the unemployment rate is solved as

$$u = \frac{\gamma}{\sigma - 1 + \gamma}. \tag{9.2}$$

This result reveals that greater union power leads to higher wages and a higher unemployment rate in autarky. With $\gamma > 0$, unions claim a higher wage rate than the average labor income, which leads to higher labor costs from the firms' perspective.

Eckel and Egger (2009) also consider the case of an open economy with multinational entrepreneurs (MNEs) to study the interaction between union–firm bargaining and foreign direct investment.[4] Firms have two options for serving consumers in the foreign country. They can concentrate production to serve foreign consumers by bearing trade costs (exporters) or set up a second production plant abroad, i.e., become MNEs, with an extra fixed cost f_m. In equilibrium, the most productive firms invest abroad while less productive firms rely on exporting, which is consistent with the standard MNE model of Helpman et al. (2004).

However, the labor market structure changes crucially when the bargaining of multinational firms is taken into account. For an MNE, if

[4] In the case of an open economy when MNEs are not allowed, the same results can be derived in (9.1) and (9.2).

an agreement in the wage negotiations with the foreign union is not reached, it can produce in its domestic plant and serve the foreign market by exporting. Hence, compared to local firms, MNEs hold a higher outside option in the bargaining and pay lower wages than exporters. As a consequence, the wage rates are depressed by MNEs, so that the unemployment rate in the open economy with MNEs is lower for $\gamma \in (0,1)$.

Moreover, the wage bargaining between firms and unions makes multinational activities more attractive, since MNEs have higher fallback profits. Eckel and Egger (2009) also find that a fall in trade costs could increase the share of multinational enterprises when the bargaining power is sufficiently large. By introducing collective bargaining, their model provides a possible explanation for the "apparent puzzle" that the foreign direct investment has surged at a time when trade costs declined (Lommerud et al. 2003). This phenomenon could not be explained in the traditional model of Helpman et al. (2004).

A few theoretical studies have examined how the bargaining between labor unions and firms affects the endogenous industrial location in NEG frameworks, such as Munch (2003) and Picard and Toulemonde (2006). They demonstrate the union power works as an agglomeration force by amplifying the home market effect in the core. Moreover, they show that bargaining power is a critical parameter to determine the industrial distribution in trade.

9.3 Search-Matching Model

The 2010 Nobel Prize in Economics was awarded to Peter Diamond, Dale Mortensen, and Christopher Pissarides "for their analysis of markets with search frictions."[5] In a perfectly competitive labor market, firms and workers match costlessly. Thus, any excess labor supply could be absorbed instantaneously by a decreasing wage rate. However, this is not realistic, since labor markets are imperfect in the real world and both unemployed

[5]Diamond (1982), Pissarides (1990), and Mortensen and Pissarides (1994) developed this theory.

workers and job vacancies coexist. By introducing matching frictions, many economists give an explanation of how labor market tightness and employment structure change in trade.

Following the setting in a search-matching model, firms post vacancies to find workers. The number of jobs created between job seekers (U) and vacancies (V) is determined by the matching function

$$M = m\left(U, V\right),$$

where $m(\cdot)$ is an increasing function of both arguments, concave and homogeneous of degree one.[6] Observe that $U = uL$, where u is the unemployment rate and L is the total labor force. Define the labor market tightness, $\theta \equiv U/V$, as the ratio of job seekers and vacancies. The vacancy-filling rate is $M/V = m(\theta, 1) \equiv m(\theta)$. Then the unemployed workers are hired at rate $\theta m(\theta)$. To hire l workers, firms post $v = l/m(\theta)$ vacancies, and the cost of providing one vacancy is c.[7]

In each period, firms are destroyed by idiosyncratic shocks with probability δ. Jobs are also destroyed by match-specific shocks with probability η. Assuming that these two shocks are independent, the actual rate of destroyed jobs is $s = 1 - (1 - \delta)(1 - \eta)$. In a steady state, flows into and out of the pool of unemployed workers are equal. Thus, how the unemployment rate is related to θ is solved as

$$u = \frac{s}{s + \theta m(\theta)},$$

which is a decreasing function of θ.

Define I^U and I^E as the present discounted asset values of an unemployed worker and an employed worker, respectively. Bellman equations of the unemployed and employed are given as

$$rI^U = b + \theta m\left(\theta\right)\left(I^E - I^U\right), \quad rI^E = w + \delta\left(I^U - I^E\right),$$

[6] Petrongolo and Pissarides (2001) provide some evidence for constant returns in the matching technology.

[7] Generally, vacancy-posting costs are assumed to be paid by a composite good, a homogeneous good, or labor.

where b denotes the unemployed benefit and r is the discount rate.

Similar to the labor union frameworks in Sect. 9.2, workers also engage in wage bargaining with firms. Assuming that each worker is treated as a marginal worker,[8] the outcome of bargaining over the division of the total surplus R from the match is determined by[9]

$$w = \text{argmax}\left(I^E - I^U\right)^{\beta} \cdot \left[\frac{\partial J(l)}{\partial l}\right]^{1-\beta},$$

where $\beta \in (0,1)$ is the bargaining power of an individual worker. In the equilibrium, the optimal hiring level l (or the number of vacancies) is determined by the profit (or the firm value) maximization.

9.3.1 Searching Frictions and Average Productivity

Incorporating the searching frictions and bargaining into the Melitz model, Felbermayr et al. (2011) illustrate that trade affects labor markets by impacting the average productivity. In their framework, the present value of a firm with employment level l and productivity φ is given as

$$J(l;\varphi) = \max_{v} \frac{1}{1+r}\left[R(l;\varphi) - w(l;\varphi)\, l - cv - f + (1-\delta)\, J\left(l';\varphi\right)\right]$$

$$\text{s.t.(i)}\ \ \frac{\partial R(l;\varphi)}{\partial l} = \frac{\sigma-1}{\sigma}\frac{R}{l}, \tag{9.3}$$

$$\text{(ii)}\ l' = (1-\chi)\, l + m(\theta)\, v,$$

where l' is the level of employment next period, $R(l;\varphi)$ represents the revenue of the firm, and r is the discount rate. The constraint (i) in (9.3) is derived from some properties of the CES utility function.

[8] This process is also called individual bargaining, which is commonly used in the framework of search and matching frictions. Considering the case of collective bargaining, Felbermayr et al. (2011) show a similar result that the vacancy–unemployment ratio increases with the average productivity.

[9] This manner is proposed by Stole and Zwiebel (1996).

Solving the problem of present value maximization and bargaining yields the wage (W) curve,[10]

$$w = \frac{\beta}{(1-\beta)(1-b)} \frac{c}{1-\delta} \left[\frac{r+s}{m(\theta)} + \theta \right].$$

This reflects how firms' behavior and labor supply interact in the presence of search costs and individual wage bargaining. Since labor market tightness is taken as given for all firms, the wage rates are identical for all heterogeneous firms in equilibrium.

According to the demand function and the bargaining solution, the labor demand (LD) curve is derived as

$$w = \left(\frac{\sigma - 1}{\sigma - \beta} \right) \widetilde{\varphi} - \frac{c}{m(\theta)} \left(\frac{r+s}{1-\delta} \right),$$

where $\widetilde{\varphi}$ denotes the average productivity.

Felbermayr et al. (2011) show that trade liberalization influences the labor markets through the channel of average productivity shifting. Productivity heterogeneity has a great impact on the unemployment–trade relationship. In other words, if firms are homogeneous, the change in labor market tightness due to trade cannot be observed.

Figure 9.1 depicts how average productivity affects the wage rate and labor market tightness. The labor demand curve shifts upward (from the solid to the dashed line) when the average productivity rises, which leads to a larger labor market tightness and a lower unemployment rate. Using data from the USA, Felbermayr et al. (2011) predict that trade liberalization lowers unemployment and raises real wages since active firms are more productive and search for workers more intensively.

9.3.2 Wage Inequality and Workers' Ability

With search and matching frictions, wage inequality is also analyzable, as shown in Helpman et al. (2010). Unlike other works in this field

[10] More details are shown in Felbermayr et al. (2011) and Felbermayr and Prat (2011).

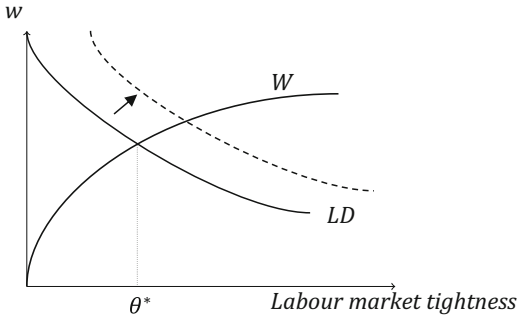

Fig. 9.1 Effect of increasing $\widetilde{\varphi}$

(e.g., Helpman and Itskhoki 2010; Felbermayr et al. 2011), they propose a new framework with ex-post match-specific heterogeneity in workers' ability. In their model, the output of each variety q depends on the firm's productivity φ, the measure of hired workers l, and the average ability of hired workers $\overline{a}$:

$$q = \varphi l^{\gamma} \overline{a}, \quad 0 < \gamma < 1.$$

The workers' ability cannot be observed directly when firms and workers are matched. Firms can invest in worker screening to obtain an imprecise signal of workers' ability. Specifically, by paying a screening cost, ca_c^{δ}/δ, a firm can identify workers with ability level below a_c. Firms determine their hiring level by choosing the optimal number of sampled workers and their own screening ability threshold of profit maximization. In the equilibrium, firms with higher productivity screen more workers, hire workers with higher ability, and pay higher wages.

Their model provides an explanation of why opening trade enhances wage inequality. When the economy is open to trade, more productive firms earn higher profits through exporting, which further enhances their incentive to screen workers and hire those with higher ability. Therefore, wage inequality is amplified by trade liberalization since the dispersion of firm profits increases.

However, the overall effect of trade on unemployment is more complicated. On one hand, surviving firms are more productive in trade, so they screen workers more intensively, which has a positive effect on employment. On the other hand, firms prefer to select workers of higher ability in an open economy, since these firms have higher average productivity and offer higher wages. Hence, the ratio of succeeding contracts over screened workers is lower in an open economy. As a consequence, the overall effect of trade on unemployment is ambiguous in the model.

9.3.3 Unemployment in Asymmetric Countries

Search-matching unemployment has also been incorporated into trade models for asymmetric countries with product differentiation. Introducing search and matching frictions into competitive models of international trade, Davidson et al. (1999) show that labor market turnover (destruction rate and matching efficiency) has important implications in determining the trade pattern. More precisely, the country with the more efficient search technology has a comparative advantage in production in a high-unemployment sector. Moreover, they find that a relatively capital-abundant large country suffers a larger unemployment rate in trade. Dutt et al. (2009) incorporate search-induced unemployment into a trade model with comparative advantage. They show that unemployment and trade openness are negatively related in a Ricardian model. In an H-O model, trade openness increases unemployment in capital-abundant countries and decreases unemployment in labor-abundant countries.

Helpman and Itskhoki (2010) study a two-country two-sector model of international trade with search and matching frictions. As a result, opening to trade leads to a larger aggregate unemployment in the country with lower labor market frictions in the manufacturing sector. Moreover, only the country with lower frictions in its differentiated good sector can benefit from trade.

A few theoretical studies have examined how industrial location and frictional labor market interact with each other in NEG models. Epifani and Gancia (2005) and Francis (2009) formulate dynamic core-periphery

models with mobile job seekers. They show that the unemployment rate in the core is lower than that in the periphery since firms earn high profits in the core and induce more new vacancies.[11]

9.4 Efficiency Wages

The question of why unemployed workers are unable to bid down the wages has been analyzed in published reports for a long time. The efficiency wage theory suggests that the answer is the negative incentive effects of a low wage rate. More precisely, workers' effort depends positively on their wages. On this basis, firms may find it profitable to pay wages in excess of market clearing. Efficiency wage models have also been incorporated into trade models to investigate the labor market outcome in globalization.

9.4.1 Fair Wage Preference

Akerlof (1982) and Akerlof and Yellen (1990) introduce a rent-sharing motive as a determinant of workers' fair wage preferences. In fair-wage-effort approaches, workers have a preference for fairness. If they feel that they get paid less than they ought to, they exert less effort in the work. Worker effort level, ε, is a function of the wage they are paid (w) and the wage perceived as fair ($\hat{w}$), such that

$$\varepsilon = \min\left\{\frac{w}{\hat{w}}, 1\right\}.$$

This framework postulates a positive relationship between work effort and wage so that the fairness-oriented behavior of workers may lead to involuntary unemployment.

Kreickemeier and Nelson (2006) modify the original model of Akerlof and Yellen (1990) by considering two factors: the skilled worker and the unskilled worker. They show that the competitive advantage between

[11] vom Berge (2013) and Yang (2014) also develop similar NEG models with matching frictions.

countries arises from country-specific preferences for fairness. In a country with a higher egalitarian preference, relative wages and employment levels of unskilled workers are negatively affected by the fairness preferences in its trading partner. Furthermore, the opening of trade increases unemployment rates in both countries.

Egger and Kreickemeier (2009) develop a model that incorporates fair wage preference and Melitz's firm heterogeneity into a general equilibrium framework. Compared to the matching unemployment models in Sect. 9.3, efficiency wage models allow us to analyze wage differentials among identical workers. Following Blanchard and Giavazzi (2003), the final output is assumed to be a CES aggregate of all available intermediate goods:

$$Y = \left[M^{-\frac{1}{\sigma}} \int_{v \in V} q(v)^{\frac{\sigma-1}{\sigma}} dv \right]^{\frac{\sigma}{\sigma-1}}, \sigma > 1.$$

The set of available intermediate goods V has measure M. Taking the final output as the numéraire, the price index corresponding to aggregated goods equals 1. Maximizing the profit of competitive final goods producers, the demand for variety v is

$$q(v) = \frac{Y}{M} p(v)^{-\sigma}.$$

Intermediate goods producers are monopolistically competitive and face the same fixed input, f units of final goods, before production. Following Melitz (2003), with marginal labor input l and productivity φ, the output is $q = \varphi l$. Then the profit-maximizing price of a firm with productivity φ is

$$p(\varphi) = \frac{w(\varphi)}{\rho \varphi \varepsilon}.$$

The fair wage (reference wage) is a weighted average of two factors: the market potential of an employer, which is related to the firm's productivity, and the average labor income $(1-u)\,\overline{w}$ ($\overline{w}$ denotes the

average wage rate). Hence, the reference wage of a firm is a geometric average of the productivity and the expected labor income:

$$\hat{w}(\varphi) = \varphi^{\chi}[(1-u)\overline{w}]^{1-\chi},$$

where $\chi \in (0,1)$ is interpreted as a fairness parameter of workers.

Profit-maximizing firms have no incentive to pay less than the fair wage. This implies $\varepsilon = 1$ and $w(\varphi) = \hat{w}(\varphi)$ in equilibrium. For $\chi = 0$, the model degenerates to the perfect labor market model with full employment. For $\chi = 1$, all firms have identical marginal production costs, i.e., $w(\varphi)/\varphi = 1$.

This model captures how the rent-sharing motive of workers impacts wage inequality and unemployment in globalization. Egger and Kreickemeier (2009) find that a higher χ leads to a higher unemployment rate and greater wage inequality in a one-country model. Moreover, they predict that opening to trade raises unemployment and wage inequality, since the firms are more productive and more dispersed with globalization. They also illustrate that a decrease in trade costs has a hump-shaped effect on unemployment and wage inequality.

Egger and Kreickemeier (2012) develop another model of international trade that features intergroup inequality between managers and workers using the approach of fair wages. Their model explains the empirical fact that globalization has been accompanied by a significant increase in both inter- and intragroup inequality.

According to their model, a firm's productivity is determined by the ability of its manager. Knowing their own managerial ability, individuals can choose whether to become a manager or a worker. Workers are taken as identical marginal inputs and managers earn the operating profits. Firms run by more able managers have a higher productivity level and make higher profits. The equilibrium manager ability cutoff (φ^*) is characterized by the labor indifference condition

$$(1-u)\overline{w} = \pi(\varphi^*),$$

where $\pi(\cdot)$ represents the firm's profit. Analogously, they show that international trade leads to a higher unemployment rate by increasing the

average productivity and wage. Trade also increases both the inequality within the two subgroups (workers and managers) and the intergroup inequality.

When heterogeneity is introduced into the framework of fair wages, the wage inequality exists among firms even if workers are identical. This feature is not observable in the model of frictional matching such as in Felbermayr et al. (2011) and Helpman and Itskhoki (2010).

Egger and Seidel (2008) explore an NEG model of efficiency wages. With more fairness preferences, the income differential between skilled and unskilled workers falls. However, the unemployment rate of unskilled workers increases. Moreover, they illustrate that fair wage preferences could force agglomeration.

9.4.2 Efficiency Wages and Monitoring

Shapiro and Stiglitz (1984) propose another approach of efficiency wages to determine the labor demand and wage rate, providing a technical explanation of how involuntary unemployment appears. Since shirking makes a firm's productivity decline, the firm needs to offer its workers higher wages to eliminate their shirking.

In the Shapiro–Stiglitz efficiency wage model, there are L identical workers, who dislike exerting effort but enjoy consuming goods. The instantaneous utility function of an individual is given as $U(w, e)$, where e is the cost of effort. Workers' distaste for effort tempts them to shirk. Their shirking will be discovered with probability q, which depends on the monitoring technology of firms. Utility takes the following form:

$$U(w, e) = \begin{cases} w & \text{if the worker shirks,} \\ w - e & \text{if the worker exerts effort } e > 0, \\ 0 & \text{if the worker is unemployed.} \end{cases}$$

There is a possibility, η, that jobs are destroyed, which is taken as endogenous. Define V_E^S and V_E^N as the expected lifetime utility of employed shirkers and non-shirkers, respectively, and V_u as the expected lifetime utility of an unemployed worker. The fundamental asset equation

for employed non-shirkers and shirkers, respectively, are

$$r V_E^S = w + (\eta + q)\left(V_u - V_E^S\right), \quad r V_E^N = w - e + \eta\left(V_u - V_E^N\right).$$

The two equations above can be solved for V_E^S and V_E^N:

$$V_E^S = \frac{w+(\eta+q)V_u}{r+\eta+q}, \quad V_E^N = \frac{(w-e)+\eta V_u}{r+\eta}. \tag{9.4}$$

Workers choose not to shirk if and only if $V_E^N \geq V_E^S$. The firm chooses to meet this non-shirking constraint (NSC) with equality, i.e., $V_E^N = V_E^S = V_E$. Using (9.4), the NSC condition can be rewritten as

$$w = r V_u + (r + \eta + q)\, e/q. \tag{9.5}$$

The asset equation for an unemployed individual is given by

$$r V_u = a\left(V_E - V_u\right), \tag{9.6}$$

where a is the job acquisition rate. In the steady state, the flow into the unemployment pool, ηL^w, equals the out flow, $a(L - L^w)$, so that

$$a = \eta L^w / \left(L - L^w\right). \tag{9.7}$$

Plugging (9.4), (9.6), and (9.7) into (9.5), the aggregate NSC is written as

$$w = e + \frac{e}{q}\left[\frac{\eta L}{(L-L^w)} + r\right]. \tag{9.8}$$

The aggregate production function in the economy is $Q = F(L^w)$. The labor demand is determined by equating the marginal product of labor to the marginal cost of labor. Assuming that firms are identical, the aggregate demand is given as

$$F'\left(L^w\right) = w. \tag{9.9}$$

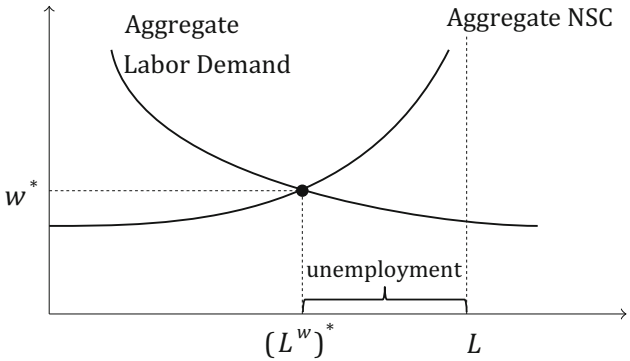

Fig. 9.2 Equilibrium unemployment

The equilibrium employed labor, $(L^w)^*$, and the equilibrium wage rate, w^*, are determined by the aggregate NSC (9.8) and the aggregate labor demand function (9.9), as shown in Fig. 9.2.

Matusz (1996) merges a model of monopolistic competition in the production of intermediate goods with the Shapiro–Stiglitz model of efficiency wages. He shows that international trade reduces the unemployment rate, since opening to trade allows for more production.

Davis and Harrigan (2011) introduce heterogeneity in productivity and monitoring technology into the Shapiro–Stiglitz efficiency wage model. Similar to Egger and Kreickemeier (2009), the intergroup inequality of workers also exists here. Heterogeneity in the monitoring ability of firms leads to different wages for identical workers in Davis and Harrigan (2011). More precisely, the firm-specific wages depend inversely on the firm-level relative monitoring abilities. They find that the national unemployment rate is little affected by liberalization with simulations. However, there is a tremendous amount of labor market churning: nearly one-fourth of all "good" jobs (jobs with above-average wages in autarky) are destroyed in trade. Workers are paid less in an open economy, since it becomes harder to survive for firms offering higher wage rates in international trade.

In NEG models with efficiency wages, firms in the more agglomerated region are able to pay higher wages, so that shirking is reduced there,

which leads to a lower unemployment rate, as shown in Suedekum (2005) and Zierahn (2013).

9.5 Minimum Wage

Minimum wage is the lowest remuneration that employers can legally pay their workers. In general, supply and demand models suggest that minimum wage binding leads to losses in aggregate welfare and employment. However, if employees have greater monopsony power in labor markets, a minimum wage can increase the efficiency of the market.

Brecher (1974) first extends the H-O model of an open economy with exogenous wage constraints (minimum wages). Unemployment occurs if and only if the equilibrium wages exceed the level required for full employment. He shows that the level of employment and welfare could be less in trade. Davis (1998) develops an H-O model of trade between two countries, one of which has flexible wages (America), while the other is bound by a minimum wage for unskilled labor (Europe). International trade equalizes factor prices between the flexible-wage and the minimum-wage economies. He shows that a move from autarky to free trade doubles European unemployment.

Abstracting from Heckscher-Ohlin-type reasons for trade, Egger et al. (2012) formally incorporate minimum wages in an NTT model with heterogeneous firms. They find that a rise in the minimum wage in a country will force inefficient intermediate good suppliers to exit the market, leading to a decline in exports. They show that trade increases the unemployment rate in all countries.

9.6 Conclusion

In this chapter, we reviewed recent theoretical studies on the relationship between trade and unemployment. Four frameworks are commonly used to collaborate frictional unemployment into international trade: labor unions, search-matching frictions, efficiency wages and fair wages, and minimum wages. There are two core intuitions for the mechanism of

unemployment. First, the wage rate claimed by workers (or unions) is higher than the level of labor market clearing. The high wage rate claim can be generated by bargaining power, fairness preferences, shirking prevention, or the binding of minimum wages determined by the government. Second, the match between job seekers and vacancies is imperfect. Due to the existence of matching frictions, job seekers and vacancies always coexist in the economy.

In trade models of competitive advantages, trade could be driven by the disparity of labor markets, such as labor market turnover (Davidson et al. 1999), the binding of minimum wages (Brecher 1974; Davis 1998), and fairness preferences (Kreickemeier and Nelson 2006). In contrast to the traditional model of competitive advantages, new trade theory allows us to study the impact of variable trade costs. For example, in Helpman and Itskhoki (2010), a lower trade cost raises the rate of unemployment when the differentiated sector has higher labor market frictions. Egger and Kreickemeier (2012) illustrate that trade freeness has a hump-shaped effect on unemployment.

Furthermore, we illustrate how Melitz-type heterogeneity impacts the labor markets in different frameworks. In the paradigm of fair wages, the unemployment rate increases in trade, since the firms are more productive and the equilibrium wage is higher. Considering search and matching unemployment, the result is opposite. Firms earn higher revenues and search for workers more intensively in trade, which leads to a lower unemployment rate. In contrast, the predictions of wage inequality are consistent: they illustrate that globalization amplifies the inequality of labor incomes in a country.

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