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Low-Skill Offshoring and Welfare Compensation Policies*

Pablo Agnese[†] and Jana Hromcová[‡]

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Abstract

We analyze the effects of low-skill offshoring on welfare. In the context of a matching model with different possible equilibria, we discuss two alternative policies that could potentially outweigh the negative welfare effects of offshoring, namely, a change of the unemployment benefits and the flexibilization of the labor market. Our calibrations for the German economy suggest that the flexibilization of the labor market can bring low-skill workers to pre-offshoring welfare levels by slightly reducing the vacancy costs, something that cannot be accomplished by meddling with the unemployment benefits scheme. In addition, we find that a full compensation can be achieved by an upgrading of low-skill workers, its size depending on the type of equilibrium involved. In sum, our analysis gives support to flexibilization and upgrading by education as best therapies for offshoring.

Keywords: Offshoring, Welfare, Unemployment benefits, Labor Market Flexibility, Upgrading.

JEL classification: F66, J68.

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1 Introduction

Critics of offshoring are mainly concerned with the welfare effects that these business practices can have on the population at large, but especially on low-skill low-wage workers. Active measures are usually called forth to palliate these negative effects of globalization, but sometimes the remedy might turn out to be worse than the disease. This paper analyzes the welfare implications of the offshoring of low-skill activities, while discussing different usual counter measures with diverging results. We evaluate two particular policies that could potentially outweigh the effects of offshoring, namely, a change in the level of unemployment benefits and a reduction of the vacancy costs—broadly understood here as the flexibilization of the labor market.

The policies we have chosen for discussion have been proposed on both sides of the political spectrum, and as with every other policy measure, they have been clumsily tailored for political advantage only to deal with difficulties in a short-time horizon. It is in this light that we aim at suggesting possible policy outcomes, while giving a word of warning which calls for discretion in coping with the offshoring 'threat'.[1]

Notice that, in focusing on the effects of offshoring and its immediate political reaction, we are emphasizing the interactions between trade and labor market policies for a hypothetical equilibrium. In order to account for some of the welfare improving effects of offshoring—e.g. the future recycling of low-skill workers and their increase in productivity levels—we will allow for an exogenous upgrading of low-skill workers that can also be considered as a supplementary compensating mechanism to those offered by the proposed policies.

We build on the previous literature of matching models like Albrecht and Vroman (2002), Rogerson et al. (2005), and Davidson et al. (2008). Albrecht and Vroman (2002) propose a matching model with endogenous skill requirements where employers create both high and low-skill vacancies and where the distribution of skill requirements across these vacancies is endogenous. It is also assumed that a low-skill job can be done by either type of worker whereas high-skill jobs can only be done by high-skill workers. Unemployment is generated by frictions and the meeting process (undirected) is taken from Diamond (1982), Mortensen (1982), and Pissarides (2000), while the wage-setting approach is of the Nash bargaining type. Low-skill workers are better off the greater the fraction of low-skill vacancies, while the opposite is true for high-skill workers. Likewise, firms with low-skill requirements are better off the greater the fraction of low-skill job candidates.

We adapt and extend the model in Albrecht and Vroman (2002) to the case of low-skill offshoring, and then use different parameter combinations that render inter-

[1]For an interesting and intense debate on the welfare implications of offshoring see the Samuelson–Bhagwati exchange (Samuelson, 2004, and Bhagwati et al., 2004).

esting comparative statics which can be used for policy recommendation analysis. In particular, we will focus the discussion on the welfare effects of offshoring for low-skill workers and the potential compensating mechanisms. As important as the welfare of those directly affected by offshoring is, special attention must also be paid to the funding limitations that such compensating policies involve. For that reason, we extend the model as to account for the government financing of such policies, and then compare the alternative welfare outcomes produced by each of the alternatives. The objective is, when possible, to bring up the welfare of low-skill workers back to pre-offshoring levels.

In the context of Albrecht and Vroman (2002), two equilibria will be discussed: the equilibrium with cross-skill matching (CSM) and the equilibrium with ex post segmentation (EPS). CSM occurs when high-skill workers and low-skill vacancies are matched, whereas EPS takes place when these potential matches do not meet (e.g. high-skill workers only work in high-skill jobs). Changing the model's parameters yields three scenarios: (i) a change from a CSM equilibrium to another; (ii) a switch from a CSM to an EPS equilibrium; and (iii) a change from an EPS equilibrium to another. These different scenarios, in combination with the policy measures, will produce different welfare effects.

The offshoring literature has seen a recent surge in welfare analysis. For example, Mitra and Ranjan (2013) suggest that a reduction in the cost of offshoring increases offshoring and the unemployment of unskilled workers, but has a positive effect on skilled workers in the form of higher wages and lower unemployment. Ranjan (2013a) argues that some employment protection policies can play an important role in protecting workers against external shocks like offshoring. He concludes that offshoring can reduce welfare even in the presence of optimal severance payments, and that some additional redistribution program might be needed to ensure welfare gains. He also points out that employment protection in the form of administrative cost of firing fails to protect workers as it unambiguously reduces welfare. On the same line, Ranjan (2013b) suggests that when unemployment arises due to both job destruction and matching frictions, a combination of severance payments and unemployment benefits is a better policy to shield workers from offshoring than either of them alone. Jung and Mercenier (2014), in turn, analytically derive the conditions under which all workers, including low-skill, might gain from the surge of offshoring. Their main policy implication is that government action should aim at reducing market rigidities, rather than thwarting adjustment, something that calls, for instance, for extensive and flexible re-training programs.

It must be observed that offshoring indicators are not easy to come by, and that indirect indicators seem to be the best choice. For that reason we rely on an intermediate imports index, as originally proposed by Feenstra and Hanson (1996). Arguably, the higher the volume of intermediate trade the higher the offshoring intensity. The rationale goes as follows: as soon as 'relocated' business units start operating from abroad, the intensity of intrafirm trade, which mostly consists of parts, components, and other inputs previously produced in the home country, will grow substantially. Firms are thus responding to import competition from low-wage countries by moving their non-skill intensive activities to foreign locations from which they can later import back.

In order to produce a fair measure of low-skill offshoring, we restrict our offshoring index to the inputs originated in the manufacturing sector of the foreign country. As a result, we are able to determine the intensity of the offshoring of material inputs (or low-skill offshoring) as opposed to that of services—which is usually in the higher end of the skill ladder. According to our numbers, the offshoring of relatively low-skill materials-related activities turns out to be consistently higher than that of services for the group of countries considered.[2] Moreover, beyond what we get from the data, firm theory holds that it is lower-skill activities that become redundant earlier and are thus at risk of being relocated first. Unlike Davidson et al. (2008) and Arseneau and Epstein (2014), we start from this hypothesis to lay out our model below and carry out our welfare analysis—that is, low-skill offshoring is significantly more prominent than high-skill and, consequently, deserving of more attention in terms of welfare effects.[3]

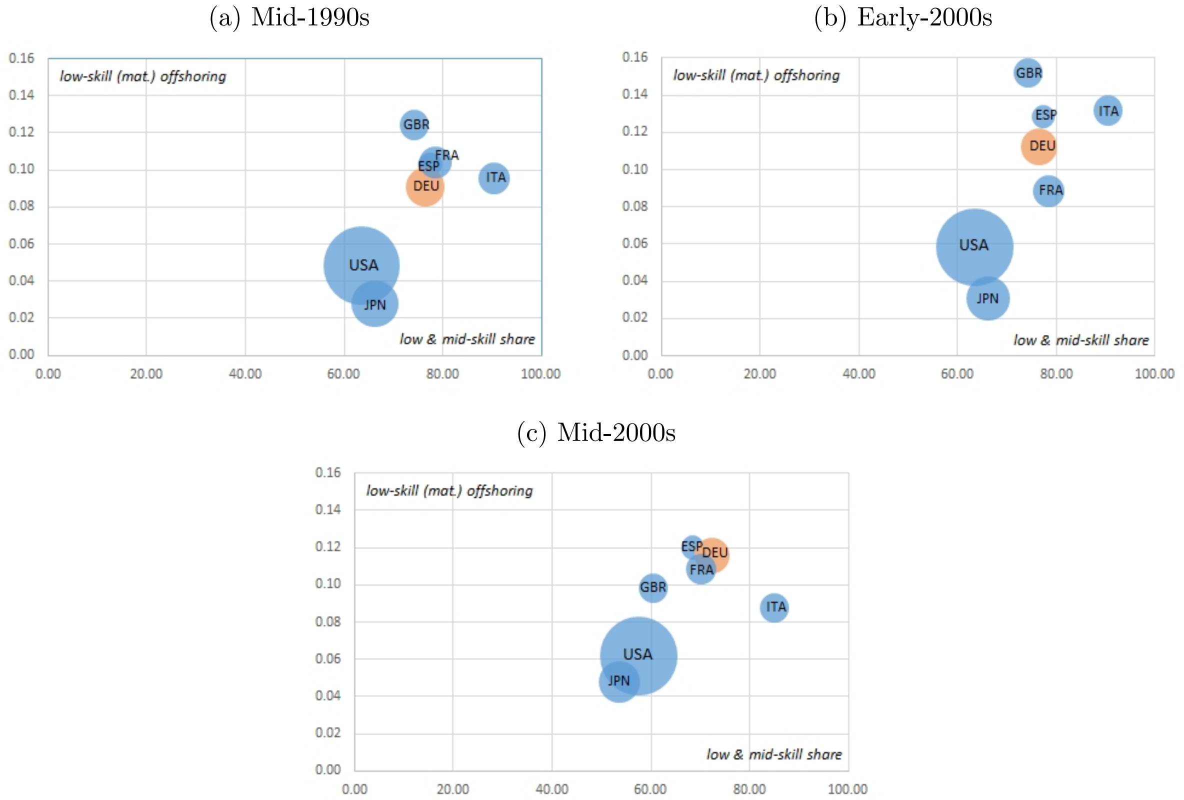
To get an idea of the significance of low-skill offshoring we calculate the indices for a group of highly developed countries, before laying out the model in full in the following sections.[4] For the purpose of calibrating our model we use German data, given that, as it clearly stands out in Figure 1, Germany is at the forefront of low-skill offshoring practices while still having an important share of workers falling into the low and mid-skill categories. Figures 1a–c show the recent evolution of materials-based low-skill offshoring (vertical axis) along with the evolution of the skill share (horizontal axis). We use data on seven of the largest economies, with the size of the bubble indicating the country's GDP weight. Notice that unlike other countries Germany displays an unambiguous upward trend of low-skill offshoring (Figures 1a–c) and, at the same time, remains very high among the countries with a significant pool of low and mid-skill level workers—this is clearly seen in Figure 1c, where Germany is positioned very high and to the right. Low-skill offshoring is likely to become a real issue in the near future, especially in places like Germany where the share of low to mid skill level workers is, even when decreasing, still non-trivial.

[2]Numerical details on the services offshoring measure are not presented here for reasons of space but are available on request.

[3]Low-skill or 'blue collar' offshoring is also more prominent in the literature—see for instance Jung and Mercenier (2014) for a recent study.

[4]This group of developed countries include: the US, Japan, Germany, France, Great Britain, Italy, and Spain.

Figure 1: Offshoring trends and skill shares, 5-year averages



Sources: for offshoring index (vertical axis) is OECD Input-Output Database (2012), for skill levels (horizontal axis) is OECD Education GPS, Chapter A (2012), and for GDP shares (bubbles) is economywatch.com and IMF (2015).

Note: low-skill is below upper secondary level, mid is secondary and post-secondary, and high is tertiary.

The remainder of the paper is organized as follows. The model, its main properties, and the possible types of equilibria are discussed in section 2. We briefly outline the strategy for the solution of the model in section 3. The welfare effects of the proposed policies as well as the additional exercise on skill upgrading are studied in section 4. Final remarks are summarized in section 5.

2 Model

We adapt the model in Albrecht and Vroman (2002) to account for the welfare effects of offshoring.[5] We also extend the model by introducing the public sector in response to the financing of the proposed compensation policies. In short, our model considers three types of agents: workers, firms, and the government.

Workers are infinitely lived and of measure one. An exogenous fraction q of these workers is low-skill, L, and the rest are high-skill, H. A worker of type i, $i = L$ or H,

[5] A description of how the model works for one type of worker can be found in Rogerson et al. (2005) and Williamson (2010).

searching for a job, seeks to maximize the expected lifetime discounted utility function

$$E\sum_{t=0}^{\infty}\rho^t x_{it}$$

where $0 < \rho < 1$ is the discount factor and x_{it} is consumption of type i at time t. Consumption is equal to the expected net income in each period, so saving is not possible.

There is free entry for firms and each firm employs one worker when active. A vacancy can be opened at an exogenous cost c, and firms place vacancies of both skill types. A fraction ϕ of vacancies is low-skill and a fraction $1-\phi$ is high-skill and their distribution is endogenous. A firm of type i, $i = L$ or H, maximizes its expected lifetime discounted profits

$$E\sum_{t=0}^{\infty}\rho^t \pi_{it}$$

where π_{it} are profits obtained by a firm of type i at time t. Further, if a firm hires a worker to occupy a low-skill vacancy the level of output is y_L, if it hires a worker to fill a high-skill vacancy then the level of output is y_H. High-skill firms are more productive than their low-skill counterparts, thus $y_H > y_L$.

A high-skill worker is allowed to take both types of jobs, whereas a low-skill worker can only fill a vacancy that corresponds to his type. If a worker of any type is employed, he gets a wage corresponding to the type of vacancy and the type of skills he has. A worker of type L (H) working in a job of type L (H) will get a wage w_L (w_H). A worker of type H working in an L type job will get $w_{L(H)}$. Wages earned by high-skill mismatched workers will be usually higher than wages of low-skill workers matched correctly with a low-skill job, hence $w_H > w_{L(H)} > w_L$.[6] If a worker is unemployed he is entitled to an exogenously given unemployment benefit b, and any worker can refuse the job if his reservation wage is not met. Moreover, jobs are lost at an exogenous rate δ.

Firms and workers meet according to a matching technology $M(u, v)$ where u represents unemployed workers (unemployment rate) and v vacancies. In this process an endogenously determined fraction γ of unemployed workers will be low-skill. In addition, arrival of jobs to workers happens at a rate $\frac{M(u,v)}{u}$ and arrival of workers to employers at a rate $\frac{M(u,v)}{v}$. If we define market tightness as $\theta = \frac{v}{u}$, we can rewrite the job arrival rate to workers as $m(1, \frac{v}{u}) = m(\theta)$ and the workers' arrival rate to firms as $\frac{\frac{M(u,v)}{u}}{\frac{v}{u}} = \frac{m(\theta)}{\theta} = z(\theta)$.

[6] In some particluar situations the market can collapse and only low-skill jobs will be offered, i.e. $\phi = 1$, and consequently all wages will converge to w_L (see Albrech and Vroman, 2002, pp. 294 and 303).

In our model, the government collects taxes from employed workers and transfers all the revenues in the form of unemployment benefits to idle workers. Depending on the necessary funds for the unemployment package, an endogenous flat tax rate τ is applied to all wages, balancing out the government budget constraint at all times.

If the match succeeds, the employed worker's expected lifetime utility is W_i and the active firm's expected lifetime profits are J_i, $i = L$, H or $L(H)$; where $i = L$ stands for a match between a low-skill worker and a low-technology firm, $i = H$ is a match between a high-skill worker and a high-technology firm, and $i = L(H)$ is the case where a high-skill worker matches with a low-skill firm. The worker's utility stems from earning the net wage $(1 - \tau) w_i$, whereas the firm's profits stem from the difference between production and incurred costs, to wit, wages and search, that is $y_i - w_i - c$.

Both workers and firms take into account that the match can be broken with probability δ. If the match does not succeed, an unemployed worker's expected lifetime utility is U_j and the expected lifetime profits of a vacant firm are V_j, $j = L$ or H. In this case the worker's utility comes from earning the unemployment benefits b, and the firm's (negative) profits come from financing a vacancy, $-c$. Workers and firms assume that a new match can occur for workers with a probability p_j^W and a new match can occur for firms with a probability p_j^F.

We thus have that W_i stands for the value of working and U_j for the value of unemployment, while J_i stands for the value of the job and V_j for the value of the vacancy of the corresponding type. There is something to bargain over if the value of working is higher than the value of unemployment, $W_H > U_H$, $W_{L(H)} > U_H$ and $W_L > U_L$, and when the value of the job is higher than the value of the vacancy, $J_H > V_H$, $J_{L(H)} > V_L$ and $J_L > V_L$. Wages are set to maximize the weighted surplus of workers and firms in a Nash bargaining process

$$\max_{\{w_i\}} \left[W_i(w_i) - U_j\right]^{\beta} \left[J_i(\pi_i) - V_j\right]^{1-\beta} \tag{1}$$

where the weighting parameter β represents the bargaining power of workers.

In the case of a successful match the Bellman equations for employed workers and active firms of type i, $i = L$, H or $L(H)$, are

$$W_i = \rho \left[(1 - \tau) w_i + \delta U_i + (1 - \delta) W_i\right], \tag{2}$$

$$J_i = \rho \left[\pi_i + \delta V_i + (1 - \delta) J_i\right], \tag{3}$$

respectively. In the case of an unsuccessful match, the Bellman equations for unemployed workers and vacant firms of type i are

$$U_i = \rho \left[b + p_i^W W_i + \left(1 - p_i^W\right) U_i \right], \tag{4}$$

$$V_i = \rho \left[-c + p_i^F J_i + (1 - p_i^F) V_i \right], \tag{5}$$

respectively.

Bellman equations for the utility and profit maximization problems are written in discrete time. In what follows we will rewrite them into the continuous form. In order to do so, we take into account the relationship between the discount factor ρ and the discount rate r,

$$\rho = \frac{1}{1+r}. \tag{6}$$

2.1 Steady State Equilibrium

Workers may experience spells of employment and unemployment. When the flow of workers into and out of each employment state coincide the steady-state equilibrium is achieved. In the steady state, low-skill workers that were working,

$$E_L = q - \gamma u, \tag{7}$$

and lose their jobs, equal the low-skill unemployed, $q - E_L$, that find a job (right hand side)

$$\delta E_L = p_L^W \left(q - E_L\right) \tag{8}$$

and high-skill workers that were working,

$$E_H = 1 - q - (1 - \gamma) u, \tag{9}$$

and lose their jobs, equal the high-skill unemployed, $1 - q - E_H$, that find a job (right hand side)[7]

$$\delta E_H = p_H^W \left(1 - q - E_H\right) \tag{10}$$

where p_L^W and p_H^W are the probabilities to find a job for low and high-skill workers, respectively.

In the described setup two types of equilibria may be realized: the equilibrium with cross skill matching (CSM) and the equilibrium with ex post segmentation (EPS). CSM occurs when high-skill workers and low-skill vacancies match, while EPS takes place when these potential matches do not meet, i.e. high-skill workers only work in

[7] Remember that there are q low-skill workers in the labor force and ϕ low-skill jobs being offered. Also, a fraction γ of unemployed is low-skill, and high-skill workers can take both types of jobs and both types of jobs meet workers at the same rate.

high-skill jobs. The type of equilibria achieved depends on the expectations of high-skill workers about the labor market and their willingness to accept a low-skill job.

2.1.1 Cross Skill Matching Equilibrium

Let us describe the equilibrium equations when high-skill workers are willing to take low-skill jobs and low-skill firms can afford to pay them.

The probability that a low-skill worker will match with a low-skill firm is

$$p_L^W = \phi m(\theta), \tag{11}$$

and the probability that a high-skill worker will match with either a low or high-skill firm is

$$\left(p_H^W\right)^{CSM} = m(\theta). \tag{12}$$

By rewriting (8) and (10), and using (7), (9), (11) and (12), we get the expressions for the unemployment rate and the fraction of low-skill vacancies (as in Albrecht and Vroman, 2002)

$$u^{CSM} = \frac{\delta\,(1-q)}{m(\theta)\,(1-\gamma) + \delta\,(1-\gamma)}, \tag{13}$$

$$\phi^{CSM} = \frac{(1-\gamma)\,qm(\theta) + \delta\,(q-\gamma)}{m(\theta)\gamma\,(1-q)}. \tag{14}$$

Rewriting (2) and using (6) for each particular case, we obtain the equations that characterize the match between low and high-skill workers with low and high-technology firms

$$rW_L = (1-\tau)\,w_L - \delta(W_L - U_L), \tag{15}$$

$$rW_H = (1-\tau)\,w_H - \delta(W_H - U_H), \tag{16}$$

$$rW_{L(H)} = (1-\tau)\,w_{L(H)} - \delta\left[W_{L(H)} - U_H\right] \tag{17}$$

where the discounted value of working must be equal to the flow of net income and the expected loss from changing the employment status. Subscripts L and H characterize low and high-skill workers, respectively, matched in the corresponding firms; and $L(H)$ stands for high-skill workers mismatched in low-skill jobs. Rewriting (4) and using (6) we get the corresponding equations for unemployed workers

$$rU_L = b + \phi m(\theta)\left(W_L - U_L\right), \tag{18}$$

$$rU_H = b + m(\theta)[\phi W_{L(H)} + (1-\phi)W_H - U_H] \tag{19}$$

where the discounted value of being unemployed must be equal to the flow of income (unemployment benefits) and the expected gain from finding a job. Rewriting (3) and using (6), the Bellman equations for the active firms are

$$\begin{aligned} rJ_L &= (y_L - w_L - c) - \delta\,(J_L - V_L)\,, & (20)\\ rJ_H &= (y_H - w_H - c) - \delta\,(J_H - V_H)\,, & (21)\\ rJ_{L(H)} &= \left[y_{L(H)} - w_{L(H)} - c\right] - \delta[J_{L(H)} - V_L] & (22)\end{aligned}$$

where the discounted value of the job must be equal to the flow of profits earned by the active firm and the expected loss from changing the labor market status (becoming inactive). Rewriting (5) and using (6), we get the corresponding equations for the inactive firms

$$\begin{aligned} rV_L &= -c + z(\theta)\left[\gamma J_L + (1-\gamma)J_{L(H)} - V_L\right], & (23)\\ rV_H &= -c + z(\theta)(1-\gamma)\,(J_H - V_H) & (24)\end{aligned}$$

where the discounted value of the vacancy must be equal to the flow of income lost by maintaining the vacancy open and the expected gain from switching to the active status. There is free entry into the market, and new firms enter while the value of the vacancy is positive. No more firms enter as the value of the vacancy decreases to zero; the free entry condition can be then expressed as

$$V_L = 0 \text{ and } V_H = 0. \qquad (25)$$

Wages for each type of match can be obtained by processing (15)-(17), (20)-(22), and (25), and by plugging them into (1) [8]

$$\begin{aligned} w_L &= \beta(y_L - c) + \tfrac{1-\beta}{1-\tau} rU_L, & (26)\\ w_H &= \beta(y_H - c) + \tfrac{1-\beta}{1-\tau} rU_H, & (27)\\ w_{L(H)} &= \beta(y_L - c) + \tfrac{1-\beta}{1-\tau} rU_H. & (28)\end{aligned}$$

Notice that the wage of a mismatched worker, $w_{L(H)}$, is lower than the one of a correctly matched high-skill worker, w_H, because of the former's lower productivity. Notice also that the wage of a mismatched worker, $w_{L(H)}$, is higher than the wage of a correctly matched low-skill worker, w_L—this is so because high-skill workers have better employ-

[8] Maximizing (1), one gets the following first order condition

$$\beta\; W_i'(w_i)\,[J_i(y_i - w_i - c) - V_i] + (1-\beta)\; J_i'(y_i - w_i - c)\,[W_i(w_i) - U_i] = 0,\; i = L,\; L(H),\; H.$$

Using (15)-(17), (20)-(22) and their derivatives, together with the free entry condition (25), we get the expressions for the corresponding wages.

ment options if they become unemployed, and the firm must then compensate for this fact.

The government taxes the wages of all employed workers at a flat rate τ, and distributes all the revenues to the unemployed workers in the form of benefits b,

$$\tau E_L w_L + \tau\phi E_H w_{L(H)} + \tau(1-\phi) E_H w_H = ub. \tag{29}$$

The condition for the CSM equilibrium to exist is that matches between high-skill workers and low-skill jobs are realized. This happens when [9]

$$(1-\tau)(y_L - c) > rU_H. \tag{30}$$

Definition 1 *In Cross Skill Matching (CSM) steady-state equilibrium, the following must hold:*
(i) workers' Bellman equations (15), (16), (17), (18) and (19),
(ii) firms' Bellman equations (20), (21), (22), (23) and (24),
(iii) Nash bargaining conditions (26), (27) and (28),
(iv) steady state conditions (8), (10), (11), and (12),
(v) free entry conditions (25),
(vi) government budget constraint (29) and
(vii) CSM equilibrium condition (30).[10]

We evaluate separately the unemployment rates of both types of workers, the low-skill unemployment rate

$$u_L = \frac{\gamma u}{q}$$

and the high-skill unemployment rate

$$u_H = \frac{(1-\gamma)u}{1-q}.$$

In CSM steady-state equilibrium the aggregate level of output is [11]

[9] Conditions $J_{L(H)} > V_L$ and $W_{L(H)} > U_H$ must hold. We can obtain the CSM equilibrium condition by processing the corresponding Bellman equations.

[10] For the set of exogenous parameters $\{b, c, q, r, y_L, y_{H,}\beta, \delta, \rho; m(\cdot), z(\cdot)\}$ the equlibrium conditions determine the set of endogenous values $\{u, v, E_L, E_H, J_L, J_H, J_{L(H)}, U_L, U_H, V_L, V_H, W_L, W_H, W_{L(H)}, \gamma, \theta, \tau, \phi\}$.

[11] Each worker employed in a low-skill firm produces y_L and each worker employed in a high-skill firm produces y_H.

$$Y^{CSM} = E_L y_L + \phi E_H y_L + (1-\phi) E_H y_H.$$

Given that we are interested in measuring welfare, we evaluate the expected lifetime utility of the average low-skill worker, Ω_L^{CSM}, and that of the average high-skill worker, Ω_H^{CSM}, as follows

$$\begin{aligned}
\Omega_L^{CSM} &= \frac{E_L W_L + (q - E_L) U_L}{q}, \\
\Omega_H^{CSM} &= \frac{\phi E_H W_{L(H)} + (1-\phi) E_H W_H + (1 - q - E_H) U_H}{1-q}.
\end{aligned}$$

The overall welfare Ω^{CSM} is the weighted sum of the two,

$$\Omega^{CSM} = E_L W_L + \phi E_H W_{L(H)} + (1-\phi) E_H W_H + (q - E_L) U_L + (1 - q - E_H) U_H.$$

2.1.2 Ex Post Segmentation Equilibrium

Let us now describe the equilibrium equations when high-skill workers are only matching with high-skill firms.

The probability that a low-skill worker will match with a low-skill firm does not change, so eq. (11) still holds, but the probability of forming a match for a high-skill worker is lower,

$$\left(p_H^W\right)^{EPS} = (1-\phi)\, m(\theta), \tag{31}$$

as these workers do not apply to low-skill vacancies anymore. The implied unemployment rate and the fraction of low-skill vacancies are, respectively

$$u^{EPS} = \frac{\delta (\gamma + q - 2\gamma q)}{\gamma (1-\gamma) [m(\theta) + 2\delta]}, \tag{32}$$

$$\phi^{EPS} = \frac{(1-\gamma) q m(\theta) + \delta (q - \gamma)}{m(\theta) (\gamma + q - 2\gamma q)}. \tag{33}$$

The Bellman equations that characterize the employed workers are (15) and (16), and the corresponding equations for unemployed workers are (18) and

$$rU_H = b + (1-\phi) m(\theta) (W_H - U_H). \tag{34}$$

The Bellman equations for the active firm are (20) and (21), and for the inactive firm are

$$rV_L = -c + z(\theta)\gamma\left(J_L - V_L\right) \tag{35}$$

and (24).[12] The zero vacancy condition (25) must also hold, and wages are determined by (26) and (27). Furthermore, the government budget constraint becomes

$$\tau E_L w_L + \tau E_H w_H = ub. \tag{36}$$

Finally, the condition for EPS equilibrium to exist is that high-skill workers are matching only with high-skill jobs

$$(1-\tau)\left(y_L - c\right) \leq rU_H. \tag{37}$$

Definition 2 *In Ex Post Segmentation (EPS) steady-state equilibrium, the following must hold:*
(i) workers' Bellman equations (15), (16), (18) and (34),
(ii) firms' Bellman equations (20), (21), (35) and (24),
(iii) Nash bargaining conditions (26) and (27),
(iv) steady state conditions (8), (10), (11) and (31),
(v) zero vacancy value conditions (25),
(vi) government budget constraint (36) and
(vii) EPS equilibrium condition (37).

Under the EPS steady-state equilibrium the aggregate level of output is

$$Y^{EPS} = E_L y_L + E_H y_H$$

and the welfare equations of the average low-skill and high-skill workers, Ω_L^{EPS} and Ω_H^{EPS}, are

$$\begin{aligned} \Omega_L^{EPS} &= \frac{E_L W_L + \left(q - E_L\right) U_L}{q}, \text{ and} \\ \Omega_H^{EPS} &= \frac{E_H W_H + \left(1 - q - E_H\right) U_H}{1-q}. \end{aligned}$$

The overall welfare Ω^{EPS} is the weighted sum of the two, as before

$$\Omega^{EPS} = E_L W_L + E_H W_H + \left(q - E_L\right) U_L + \left(1 - q - E_H\right) U_H.$$

[12]Notice that equations (34) and (35) now show that high-skill unemployed workers are only taking high-skill jobs, and low-skill firms are ony hiring low-skill workers.

3 Solving the model

The model can be solved numerically. In order to do so we need to specify the matching function. We assume that $M(u,v) = 2\sqrt{uv}$, which implies

$$m(\theta) = 2\sqrt{\theta} \quad \text{and} \tag{38}$$

$$z(\theta) = \frac{2}{\sqrt{\theta}}. \tag{39}$$

Using the Bellman equations for the expected lifetime utility of a vacant firm, (23) and (24) for the CSM equilibrium, and (35) and (24) for the EPS equilibrium, and the free entry condition (25), we obtain the following

$$\text{when } V_L = 0, \; c = z(\theta)\left[\gamma J_L + (1-\gamma) J_{L(H)}\right], \tag{40}$$

$$\text{when } V_H = 0, \; c = z(\theta)(1-\gamma) J_H \tag{41}$$

for the CSM equilibrium, and

$$\text{when } V_L = 0, \; c = z(\theta)\gamma J_L, \tag{42}$$

$$\text{when } V_H = 0, \; c = z(\theta)(1-\gamma) J_H \tag{43}$$

for the EPS equilibrium. Combining all the corresponding equilibrium equations we obtain the combinations of γ and θ, or $\gamma = f_{V_L=0}(\theta)$, for which (40) or (42) hold, and the combinations of γ and θ, or $\gamma = f_{V_H=0}(\theta)$, for which (41) or (43) hold too. In general, for $\gamma \in (0,1)$, $\gamma = f_{V_L=0}(\theta)$ is increasing and $\gamma = f_{V_H=0}(\theta)$ is decreasing. The intersection of the two loci determines the fraction of low-skill unemployed γ and the market tightness θ. Once these two values are known, the solution of the model can be obtained using the corresponding equilibrium conditions.[13]

4 Calibration and comparative statics

In the offshoring literature offshoring is often identified as a source of skill-biased technical change. In our setting, skill-biased technical change can be seen as an increase of output produced in high-skill jobs while the output of low-skill jobs remains constant. Similarly, this can also be represented as a fall in the productivity levels of low-skill workers while keeping the productivity of high-skill workers fixed. Hence, introducing cheap imports due to a liberalization process or the increase of offshoring will reduce

[13] More details about the calculations of the equilibrium loci can be found in the Appendix.

the value of the output of low-skill jobs.[14]

In this section we calibrate our model to the German economy during 2000–2014. We use the following baseline parameters: the rate at which the employment relationship is broken is $\delta = 0.09$, meaning that jobs last on average 11 years; agents discount the future at a constant rate $r = 0.023$, which corresponds to the average real interest rate in the data; there are $q = 0.745$ low-skill workers in the labor force (the average value of workers with below upper secondary and secondary education in 2000 and 2011); and the bargaining power of workers is the same as that of the firms, $\beta = 0.5$, so the Hocios condition holds.

Further, the output produced by high-skill workers in a high-skill firm is assumed to be $y_H = 1.2$. The value of the output in a low-skill firm will change in order to generate a CSM or an EPS equilibrium.[15] We choose an output gap of 20 percent for the calibration of the parameters. Thus, the baseline productivity of low-skill workers is $y_L = 1$.

Unemployment benefits in Germany amount to around 63 percent of previously perceived wages—the parameter b that leads to such a value is $b = 0.5$. Moreover, the cost of opening a vacancy is set at $c = 0.25$, implying an equilibrium unemployment rate of 8 percent, which is roughly equal to the average value found in the data. When simulating the effects of offshoring, we open the productivity gap between high and low-skill workers and aim to 'destroy' 15 percent of the low-skill vacancies ϕ.

4.1 Effects of offshoring

We carry out a comparative statics exercise to account for different policy measures that can possibly compensate for the welfare effects of offshoring. The purpose of this exercise is to theoretically examine the effects of offshoring on the whole economy and on low-skill workers in particular.

We describe three possible scenarios: (i) the movement from a CSM equilibrium to another CSM; (ii) a switch from a CSM equilibrium to an EPS equilibrium; and (iii) the movement from an EPS equilibrium to another EPS. Notice that in the cases (i) and (ii) we might end up with a set of parameters where both equilibria are possible, and where the actual outcome depends on the expectations of high-skill workers about the economy and their willingness to accept, or not, a low-skill job.

Let us now preview the general initial effects of offshoring in our model—that is, prior to any compensating policy measure. As seen in Tables 1 and 2, a reduction in

[14] Remember that offshoring intensity can be measured as an intermediate imports ratio as we did above.

[15] Notice that the EPS equilibrium is more likely to exist when the productivity gap between the two types of workers is high, i.e. when $y_H >> y_L$, and consequently the wages in low-skill firms are too low to entice high-skill workers into these jobs.

the productivity of low-skill workers yields the following qualitative results: 1) it raises the overall and low-skill unemployment rates, u and u_L; 2) it reduces the fraction of vacancies that are low-skill, ϕ; 3) it brings down the wages in low-skill jobs, w_L and $w_{L(H)}$; 4) it cuts production down, Y; and 5) it reduces overall and 'low-skill' welfare, Ω and Ω_L (Table 2).

Table 1: Employment and wage effects of offshoring

		unemployment				*wages*			
CSM equilibrium	y_L	u	u_L	u_H	ϕ	w_L	$w_{L(H)}$	w_H	Y
Baseline (CSM)	1.1	0.041	0.041	0.039	0.95	0.834	0.837	0.887	1.057
Offshoring (CSM)	1.072	0.048	0.050	0.041	0.81	0.804	0.818	0.882	1.027
Offshoring (EPS)	1.072	0.070	0.067	0.079	0.55	0.800	–	0.912	1.027
		unemployment				*wages*			
EPS equilibrium	y_L	u	u_L	u_H	ϕ	w_L	$w_{L(H)}$	w_H	Y
Baseline (EPS)	1.00	0.079	0.080	0.077	0.490	0.730	–	0.913	0.968
Offshoring (EPS)	0.94	0.095	0.102	0.075	0.416	0.673	–	0.915	0.912

Note: Offshoring is represented by a decrease in the productivity of low-skill workers y_L that generates a 15% drop in the share of low-skill vacancies ϕ.

Note that the changes in the unemployment rate, wages and welfare of high-skill workers depend on the kind of equilibrium—they all worsen under CSM but improve when switching to EPS.

We now proceed to analyze three comparative statics exercises, involving appreciably different policy measures with quite different outcomes—a change of the unemployment benefits, a reduction of the vacancy costs, and the skill upgrading of low-skill workers.

Table 2: Welfare effects of offshoring

CSM equilibrium	Ω	Ω_L	Ω_H
Baseline (CSM)	34.83	34.77	35.02
Offshoring (CSM)	33.57	33.26	34.44
Offshoring (EPS)	33.46	32.40	36.56
EPS equilibrium	Ω	Ω_L	Ω_H
Baseline (EPS)	31.10	29.32	36.29
Offshoring (EPS)	28.97	26.62	35.81

4.1.1 Policy 1: Unemployment Benefits

It is a well-known fact that an increase in the unemployment benefits b increases the reservation wage of workers and thus obliges firms to pay them more. Naturally, this has a positive affect on the worker's utility but, on the other hand, it also induces workers to remain idle. Besides, to finance the increase of b taxes need to be raised, thus reducing the workers' net income. As a result, a negative effect of taxes can prevail. Conversely, lowering b increases the net wages of both types of workers, even when this increase will not be enough to compensate for the decrease in utility experimented by the offshoring-related displaced workers.

Figure 2 summarizes the results, for both the equilibria discussed, of our calibration on the welfare of low-skill workers using German data. We conclude that changing the level of unemployment benefits to higher or lower levels (horizontal axes in Figure 2) turns out to be ineffective for compensating workers for the loss of welfare due to offshoring—leaving a permanent 'welfare gap' between the original equilibrium (bold point in Figure 2) and the 'offshoring equilibria' (depicted by the continuous and dotted lines in Figure 2).[16]

Figure 2: Unemployment benefits under different equilibria

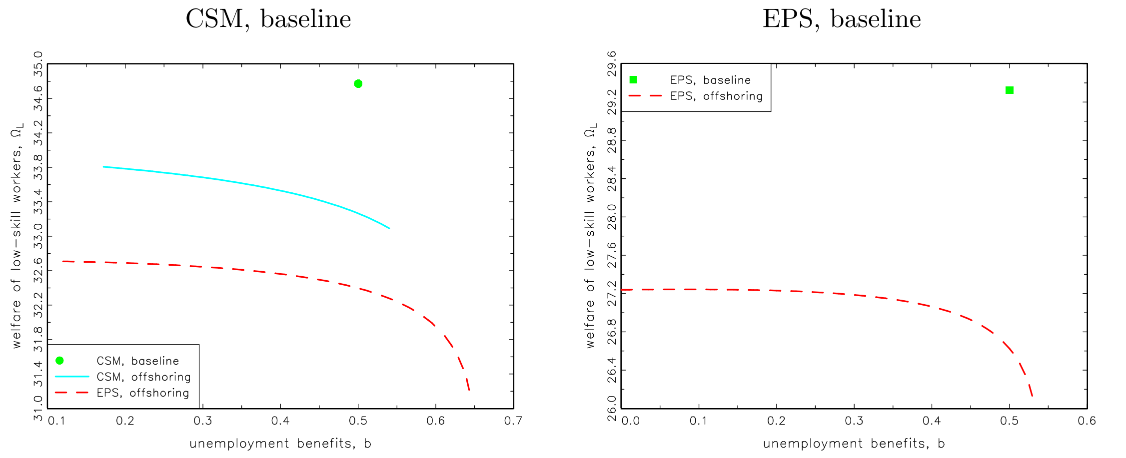
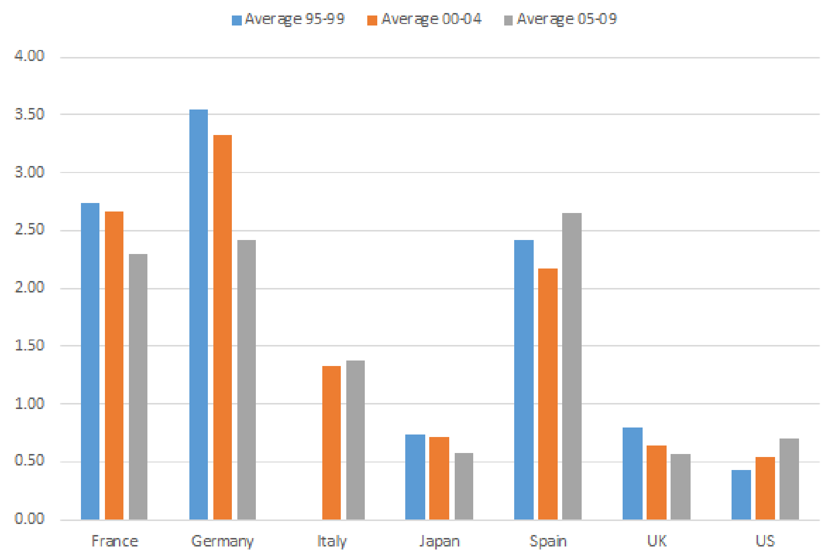


Figure 3 adds some color to our previous exercise and shows how active governments have been for the last 15 years in relation to labor market policies in general. Unlike in other countries, Germany has committed itself to a substantial reduction in its active and passive policy measures. According to OECD data, German public expenditure involving active and passive measures has fallen more than 1 percentage point of GDP during that period. This, however, would fall short of a complete recovery in terms of the welfare of low-skill workers, as previously seen in Figure 2. Let us now turn our attention to our second policy alternative: an increase in labor market flexibility.

[16]The welfare effect of offshoring in Figures 2 and 4 is the vertical drop from the bold dot to the lines below; then moving along the lines in either direction results in the compensating mechanism.

Figure 3: Labor market policies spending, % of GDP



Source: OECD Labour Market Programmes Dataset (2013). Notes: public expenditures on both active and passive measures; data for Italy 95–99 were not available.

4.1.2 Policy 2: Labor market flexibility

Let us discuss the effects of the flexibilization of the labor market by way of a reduction of the vacancy costs c. A fall of y_L due to offshoring—that is, one that generates a 15 percent drop in the share of low-skill vacancies (ϕ) as assumed earlier—results in a welfare loss that can be completely offset by a cutback of the vacancy costs.[17]

As in the previous exercise, we are interested in a compensating mechanism that would bring the welfare of the low-skill group back to its pre-offshoring level. As seen in Figure 4, this can be achieved by allowing for a reduction in the vacancy costs—in terms of the figures this is accomplished when the lines intersect the value given by the vertical axes at which the original equilibria stand (bold dots). The size of the cutback depends on the equilibria involved and range from 13 percent in the CSM–CSM case (continuous line left panel), to 19 and 20 percent when CSM–EPS (dotted line left panel) and EPS–EPS (right panel) respectively.

Flexibilization encourages hiring and this, in our setting, would drive wages up. The raise would be extensive to both low and high-skill workers yet, the truth be told, it would fall more largely on the latter. Regardless, welfare in general is increased as a result of flexibilization and the welfare of low-skill workers in particular can be brought back to pre-offshoring levels.[18]

[17] See Tables 1 and 2 above for the quantitative effects of offshoring in terms of employment, wages, and welfare.

[18] We have a sizable amount of data from our calibrations that is available on request. The main

Figure 4: Flexibilization under different equilibria

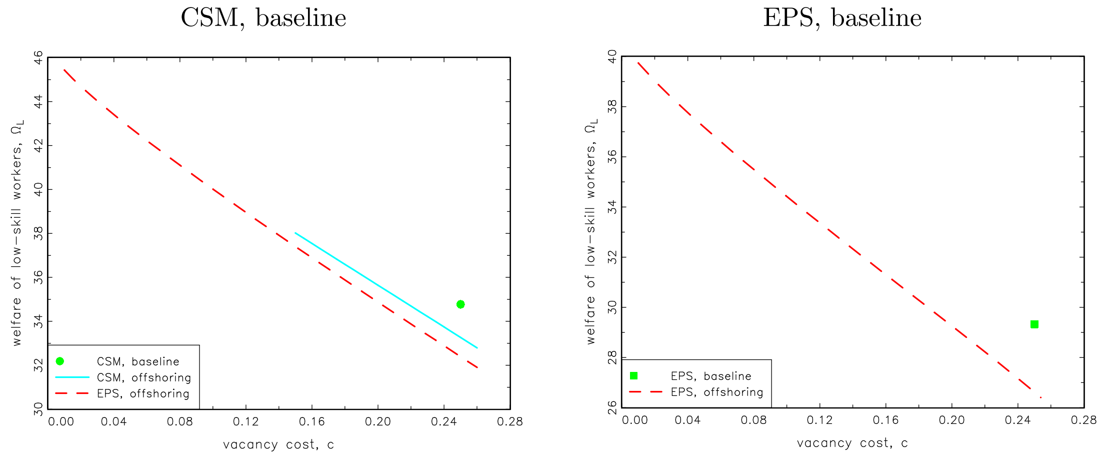
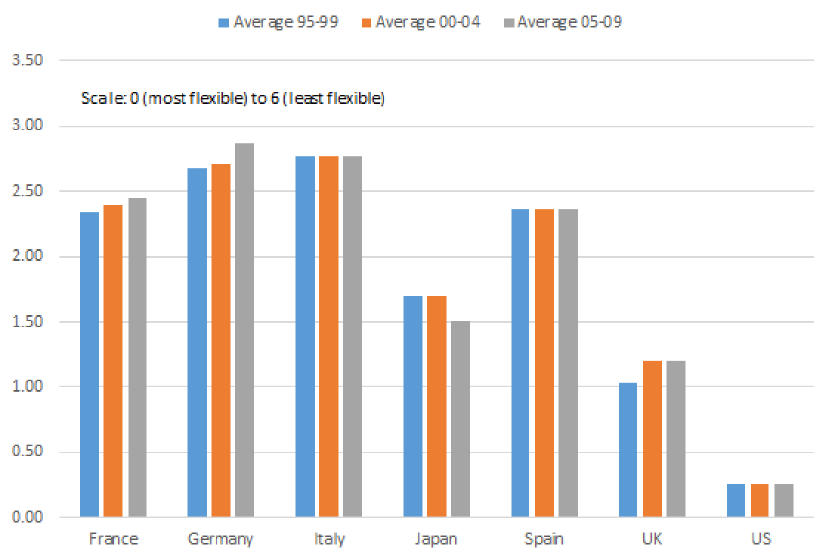


Figure 5 shows the changes in the level of employment protection for the same group of countries as in the previous sections. We can see that employment protection has generally moved toward less flexibility in recent years, with Germany in particular moving slightly but consistently on the higher end—something which is clearly at odds with mitigating the welfare effects of offshoring.

Figure 5: Employment protection, strictness indicator



Source: OECD Employment Protection Dataset (2013).

Notes: OECD indicator (v.1) of regulations on dismissals and use of temporary contracts.

Notice that even when c in our model simply refers to the cost of creating and maintaining a vacancy, it is still accounted for in the OECD strictness indicator as this

point for us, however, was to show that the policy presented here seems to be achievable and within the reach of most policy makers.

includes both the regulations on dismissals and the use of temporary contracts—the latter having a direct impact on the hiring process of firms. Vacancy costs usually include advertisement, the time cost of the internal recruiter, the time cost taken by the interviews, drugs screens and background checks, and various pre-employment assessment tests.

As for the indicator presented here, a reduction of the vacancy cost may be brought about by loosening up the regulations involving temporary workers, as this will probably reduce the administrative burden faced by the firms. Likewise, employment subsidies seem bound to have the same effect on hiring (Phelps, 1994), this time at the expense of the taxpayer or lower welfare entitlements. Finally, it can be argued too that reducing the firing costs can bring c down as this can be broadly thought of as including the costs which firms will have to face sooner or later. Labor market policies can strongly define the pattern of trade and the effects of trade in general (see Helpman and Itskhoki, 2007), and offshoring is just another form of trade.[19]

4.1.3 Addendum: Upgrading of low-skill workers

Skill upgrading can be understood as a change in relative wages, favoring the high-skill, reflecting a change in productivity levels.[20] An expected outcome of offshoring involves the recycling and upgrading of those low-skill workers who have lost their jobs. To be sure, once those low-skill jobs have been relocated, firms will have more room for new goods and services that will be produced with new technologies using higher skill requirements. Workers who are able to seize the opportunity by getting trained in new skills and thus by becoming high-skill workers will eventually command higher wages.

Here we pose a very simple question. Assuming that the offshoring threat will make low-skill workers seek to change their status to high-skill, then how much of a drop in the share of low-skill workers q will be needed to compensate for the welfare loss of offshoring?[21] Given that low-skill workers are now able to move up the skill ladder our policy goal will be total welfare (Ω). The workers that remain low-skill, however, will still bear considerable welfare losses. Table 3 presents the results of our calibration for Germany, in a similar way as we did before.

[19] Davidson and Matusz (2006) evaluate the effects of four different policies in the broader context of globalization: unemployment benefits, training subsidies, employment or wage subsidies. They conclude that wage subsidies are the preferred policy as they give the highest incentive for re-employment.

[20] Empirical evidence on this subject abounds; see, among several others, Berman et al. (1994) and Feenstra and Hanson (1996) for the US, Geishecker and Görg (2005) for Germany, Head and Ries (2002) for Japan, and Hijzen et al. (2005) for the UK. On the theoretical side see for instance Fang et al. (2008) and Anwar and Rice (2009), among others.

[21] Notice that high-skill workers, even when in low-skill occupations, can still command higher wages than low-skill workers, or $w_{L(H)} > w_L$. Be also aware that the mechanism by which workers react to offshoring by improving their skills is considered exogenous.

Table 3: Offshoring, skill upgrading and welfare

CSM equilibrium	y_L	q	ϕ	Ω	Ω_L	Ω_H
Baseline (CSM)	1.1	0.745	0.95	**34.83**	34.77	35.02
Offshoring (CSM)	1.072	0.745	0.81	33.57	33.26	34.44
*Skill upgrading**	1.072	**0.715**	0.74	33.56	33.10	34.70
Offshoring (EPS)	1.072	0.745	0.55	33.46	32.40	36.56
Skill upgrading	1.072	**0.485**	0.36	**34.84**	31.96	37.53

EPS equilibrium	y_L	q	ϕ	Ω	Ω_L	Ω_H
Baseline (EPS)	1.00	0.745	0.490	**31.10**	29.32	36.29
Offshoring (EPS)	0.94	0.745	0.416	28.97	26.62	35.81
Skill upgrading	0.94	**0.545**	0.284	**31.10**	26.48	36.64

* CSM equilibrium does not exist for lower levels of the low-skill share q.

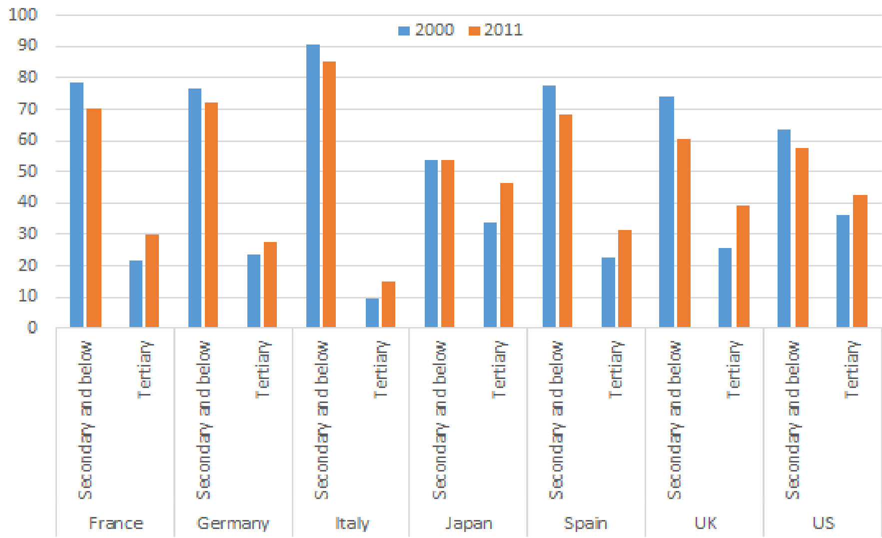
Note: Offshoring is, as before, assumed to be equal to a drop in the productivity of low-skill workers y_L that generates a 15% drop in the share of low-skill vacancies ϕ.

The uppermost segment of the table shows that the economy remains at a CSM equilibrium as long as $q \geq 0.715$, and that lower levels of q lead to a switch CSM–EPS. Notice that only when switching into the EPS equilibrium the pre-offshoring level of welfare can be achieved—this is seen on the second segment of the upper panel and on the bottom panel under 'skill upgrading'. Respectively, the share of low-skill workers q needs to go down to around 49 (CSM–EPS) and 55 percent (EPS–EPS) to get back to the initial welfare level.

Figure 6 shows a clear trend pointing in the direction of skill upgrading of low-skill workers since the early 2000s. Seemingly, people are fast adapting to the ever increasing requirements of globalized firms by acquiring more skills by way of higher levels of education. In the particular case of Germany, special concern should be placed on the still high share of relatively low to mid-skill segments of the population—the second highest in the sample as of 2011.

It can be argued that in the lack of a consensus from the majority of the political forces to effect one of the two alternatives previously discussed, there is still the possibility of upgrading for those at the bottom of the skill ladder. This, as we can see, will likely bring welfare to pre-offshoring levels. Of course, this upgrading can also be encouraged by a combination of policies aimed at the re-employment of dismissed workers (see, among others, Phelps, 1994, Davidson and Matusz, 2006, and Jung and Mercenier, 2014).

Figure 6: Education attained (25-64 year-olds, %)



Source: OECD Education GPS, Chapter A (2012).

Notes: low is below upper secondary level, mid is secondary and post-secondary, and high is tertiary.

5 Conclusions

We have relied on a matching model to perform a quantitative analysis of the effects of low-skill offshoring on the welfare of the economy. We have adapted and extended the model by Albrecht and Vroman (2002) to assess the effect of two government policies: unemployment benefits and labor market flexibilization.

We have shown that, in the case of Germany, the welfare loss due to low-skill offshoring can be compensated by a flexibilization policy—it would only take a relatively small reduction in the vacancy cost to achieve the pre-offshoring welfare levels. Unemployment benefits, on the other hand, cannot compensate for the negative welfare effects of offshoring as the positive effects of higher benefits is offset by the negative effect of its financing. Thus, the recommended welfare improving tool is flexibilization, which also implies work incentives and an increase in economic activity.

Furthermore, an additional exercise reveals that if low-skill workers adjust themselves to higher skill requirements (upgrading) the welfare loss can also be compensated. These adjustments vary widely and depend on the equilibria involved, and could be encouraged by re-employment and re-training programs as discussed in the text.

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Appendix

Solution of the model: Cross Skill Matching Equilibrium

Taking into account (25) and rewriting (20), (21) and (22) we get

$$J_L = \frac{y_L - w_L - c}{r+\delta}, \tag{44}$$

$$J_H = \frac{y_H - w_H - c}{r+\delta}, \tag{45}$$

$$J_{L(H)} = \frac{y_L - w_{L(H)} - c}{r+\delta}. \tag{46}$$

Using (18) and (19) in combination with (26)-(28) and (15)-(17) we can write

$$rU_L = \frac{b\,(r+\delta) + \beta\phi m(\theta)\,(1-\tau)\,(y_L - c)}{r+\delta+\phi m(\theta)\beta}, \tag{47}$$

$$rU_H = \frac{b\,(r+\delta) + \beta m(\theta)\,(1-\tau)\,[\phi y_L + (1-\phi)\,y_H - c]}{r+\delta+m(\theta)\beta}. \tag{48}$$

Plugging (44), (46), (26), (28), (47), (39), (14) and (38) into (40) we get the combination of γ and θ for which the free entry condition for low-skill workers holds, $\gamma = f_{V_L=0}(\theta)$

$$\begin{aligned} V_L = {} & 0 \text{ locus: } 0 = -\,c\,(r+\delta)\sqrt{\theta_L} + 2\,(1-\beta)\,(y_L - c) \\ & -2\,(1-\beta)\,\frac{b\,(r+\delta)}{(1-\tau)}\left[\frac{\gamma}{r+\delta+2\sqrt{\theta_L}\beta\phi} + \frac{1-\gamma}{r+\delta+2\sqrt{\theta_L}\beta}\right] \\ & -4\,(1-\beta)\,\beta\sqrt{\theta_L}\left[\frac{\gamma\phi\,(y_L-c)}{r+\delta+2\sqrt{\theta_L}\beta\phi} + \frac{(1-\gamma)\,[\phi y_L + (1-\phi)\,y_H - c]}{r+\delta+2\sqrt{\theta_L}\beta}\right] \end{aligned}$$

where $\phi = \phi\left(\sqrt{\theta_L}\right)$ is given in (14). It is a third degree polynomial in $\sqrt{\theta_L}$. Given that b, c, q, r, y_L, β, δ and τ are predetermined, this polynomial gives us the value of $\sqrt{\theta_L}$ for a given γ. We solve it numerically. Plugging (45), (27), (48), (39), (14) and (38) into (41) we get the combination of γ and θ for which the free entry condition for high-skill workers holds, $\gamma = f_{V_H=0}(\theta)$

$$\begin{aligned} V_H = {} & 0 \text{ locus: } 0 = \theta_H \;\; 2c\,(r+\delta)\,\beta\,(1-\tau) + \\ & \sqrt{\theta_H}\;\;\left\{c\,(r+\delta)^2\,(1-\tau) - 4(1-\gamma)\,(1-\beta)\,\beta\,(1-\tau)\,\tfrac{q(1-\gamma)}{(1-q)\gamma}\,(y_H - y_L)\right\} \\ & -2(1-\gamma)\,(1-\beta)\,(y_H - y_L)\,\beta\,(1-\tau)\,\tfrac{\delta(q-\gamma)}{(1-q)\gamma} \\ & -2(1-\gamma)\,(1-\beta)\,[(1-\tau)\,(y_H - c) - b]\,(r+\delta)\,. \end{aligned}$$

This locus is a second degree polynomial in $\sqrt{\theta_H}$. An analytical solution is applied.

Solution of the model: Ex Post Segmentation Equilibrium

Taking into account (25) and rewriting (20) and (21) we get (44) and (45). Using (18) and (19) in combination with (26), (27), (15) and (16) we get (47) and

$$rU_H = \frac{b\,(r+\delta) + \beta\,(1-\phi)\,m(\theta)\,(1-\tau)\,(y_H - c)}{r+\delta+(1-\phi)\,m(\theta)\beta}. \tag{49}$$

Plugging (44), (26), (47), (39), (33) and (38) into (42) we get the combination of γ and θ for which the free entry condition for low-skill workers holds, $\gamma = f_{V_L=0}(\theta)$

$$\begin{aligned} V_L &= 0 \text{ locus: } 0 = \theta_L \;\; 2c\,(1-\tau)\,\beta\tfrac{q(1-\gamma)}{\gamma+q-2\gamma q} + \\ &\sqrt{\theta_L}\;\left\{c\,(1-\tau)\,\beta\tfrac{\delta(q-\gamma)}{\gamma+q-2\gamma q} + c\,(r+\delta)\,(1-\tau)\right\} \\ &-2\gamma\,(1-\beta)\,[(1-\tau)\,(y_L-c)-b]\,. \end{aligned}$$

Plugging (45), (27), (49), (39), (33) and (38) into (43) we get the combination of γ and θ for which the free entry condition for high-skill workers holds, $\gamma = f_{V_H=0}(\theta)$

$$\begin{aligned} V_H &= 0 \text{ locus: } 0 = \theta_H \;\; 2c\,(r+\delta)\,(1-\tau)\,\beta\tfrac{\gamma(1-q)}{(\gamma+q-2\gamma q)} + \\ &\sqrt{\theta_H}\;\left[\begin{array}{c} -c\,(r+\delta)\,(1-\tau)\,\beta\tfrac{\delta(q-\gamma)}{(\gamma+q-2\gamma q)} \\ +c\,(r+\delta)^2\,(1-\tau) - 4(1-\gamma)\,(1-\beta)\,\beta\,(y_H-c)\,\tau\tfrac{\gamma(1-q)}{(\gamma+q-2\gamma q)} \end{array}\right] + \\ &2(1-\gamma)\,(1-\beta)\,\beta\,(y_H-c)\,\tau\tfrac{\delta(q-\gamma)}{(\gamma+q-2\gamma q)} \\ &-2(1-\gamma)\,(1-\beta)\,(r+\delta)\,[(1-\tau)\,(y_H-c)-b]\,. \end{aligned}$$

We can see that both loci are second degree polynomials in $\sqrt{\theta_L}$ and $\sqrt{\theta_H}$, respectively.

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