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Abstract

We provide a simple model of trade, job task offshoring and social insurance to identify economic mechanisms through which the interplay between insurance design, (final-goods) trade and job task offshoring determine domestic producer conditions. A skill-abundant home country that may have more productive workers relocates low-skill job tasks to a labor-abundant foreign country. Only the home country provides social insurance to its citizens. Using a simple conceptualization of social insurance targeting the main mechanisms through which insurance design impacts on producer conditions, we formalize productivity, wage-restrictive, compensation, cost-enhancing, cost-redistributive and labor-supply effects of insurance. The home country's labor productivity is superior if the health status of the labor force is improved by health insurance. Generous unemployment insurance trigger binding reservation wages, giving rise to labor-supply effects that lead to a domestic overspecialization of production in trade equilibrium. This tendency is stronger with an insurance design that incorporates a cost-coverage link. Offshoring can introduce, enhance or reduce unemployment in the unskilled labor market depending on a combination of market-related factors and insurance design. In particular, offshoring may give rise to a combination of market-related effects that offset unskilled worker dependency on generous unemployment insurance. An insurance regulation that provides generous unemployment benefits and stipulates cost-redistribution can give rise to a compensation effect through which offshoring generates a high-skill wage reduction.

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1. Introduction

In the last decades, a worldwide reduction of transaction and communication costs has triggered a rapid increase of production offshoring from the Western world to low-wage countries.[1] This process, whereby selected production parts are relocated abroad, leads to a reorganization of production with international transfers of particular job tasks. While the relocation of job tasks gives rise to intermediate input trade driven by the same underlying factors as trade in final goods, such as specialization due to comparative advantage, it can lead to other market effects. (We will henceforth use the term trade to refer to final-goods trade unless otherwise stated.) In contrast to trade, offshoring may lead to an effect that resembles labor-augmenting technological progress (Grossman and Rossi-Hansberg, 2008). As a consequence, labor-market effects of trade may not be applicable to those of offshoring. In addition, studies that investigate labor-market impacts of offshoring in settings that do not simultaneously allow for trade may provide a less than satisfactory description for economies integrated through trade. We provide a model that identifies economic mechanisms through which the interplay between insurance design, (final-goods) trade and job task offshoring determine domestic producer conditions. Our main motivation is to lay bare these economic relationships in a way that provides a generally applicable description of insurance systems in Western economies.

Using a simple conceptualization of social insurance targeting the main mechanisms through which insurance design impacts on producer conditions, we formalize productivity, wage-restrictive, compensation, cost-enhancing, cost-redistributive and labor-supply effects of insurance. This approach allows us to examine the role of insurance design in determining market implications of trade and offshoring. Labor-market adjustments are central in this respect, and to achieve comparability across insurance systems, we abstain from explicitly investigating exact financing links. Placing our main focus on the interaction between insurance design and general-equilibrium trade-theoretic fundaments from a producer perspective, we therefore avoid considering optimal insurance issues. Our approach enables a comparison of outcomes in economic systems relying on a direct coverage of insurance costs through private insurance to those incorporating cost-redistribution through public-insurance provision.

Our trade-theoretic setting is a Heckscher-Ohlin version of the Grossman and Rossi-Hansberg (2008) model modified to allow for international labor productivity differences. A skill-abundant home country with social insurance offshores low-skill tasks to a labor-abundant foreign country. Social insurance takes the form of a general provision on health and unemployment insurance.[2] Health insurance that improves the health status of the labor force raises labor productivity, giving rise to a (Hicks-neutral) productivity advantage in the home country.[3] Job task offshoring may therefore be driven by relative factor endowment and productivity differences, comprising sources of comparative advantage that can prevail in a North-South country setting. As the same economic fundamentals give rise to trade and offshoring, offshoring incentives depend upon whether markets have already undergone adjustments to trade.

This paper builds on a long tradition of investigating labor-market regulations in Heckscher-Ohlin settings. In formalizing that unemployment insurance gives rise to reservation wages, our work relates to minimum wage applications in the field (initiated by Brecher 1974). The resulting distortion effects on factor returns lies at the heart of our study, where the provision of unemployment insurance can affect the relative supply of skilled labor available for production. Yet, our study does not merely provide a repetition of previously identified regulation effects in

[1] See e.g. Baldwin (2006).

[2] For historical reasons, social insurance systems in Western countries include unemployment, health and/or pension insurance. Since the scope of this paper is to investigate static mechanisms linking social insurance and production offshoring, and the main effect of pension insurance in this respect is to raise insurance costs (which are otherwise accounted for in the model), it is left out from the analysis.

[3] This is not the first paper formalizing a productivity effect of health insurance. See, e.g., Dey and Flinn (2005).

Heckscher-Ohlin settings. The use of Grossman and Rossi-Hansberg's (2008) model enables us to extend beyond prior work on regulation effects in these settings to extract economic effects of insurance provision on market adjustments to trade and offshoring.

This paper is related to several studies on trade, offshoring and/or labor-market rigidities outside the standard Heckscher-Ohlin framework. In closely related work by Wright (2011) and Kohler and Wrona (2012), search-costs frictions and/or efficiency wages are incorporated into (other versions of) the Grossman and Rossi-Hansberg (2008) model. In contrast, our focus on the role of insurance design associates our contribution to prior work on the trade-adjustment impact of labor-market regulation (see, e.g., Davis 1998, Moore and Ranjan 2005). Similarly to Egger and Kreikemeier (2008), who introduce efficiency wages in a fragmentation model, our investigation incorporates general-equilibrium trade-theoretic fundaments through which offshoring and trade affect relative factor and goods prices. As a consequence, we replicate some of their main outcomes using a regulatory-based approach. As many Western labor markets are strongly regulated, we argue that the role of insurance design is key in identifying labor-market adjustments of offshoring and trade in these countries.

The rest of this paper is organized as follows. The next section contains a concise review of related research. The model is presented in section 3, including descriptions of trade equilibrium and decomposed wage effects of job task offshoring in the first and second subsection. The last section concludes.

2. Related Research

In this section, we review trade-theoretic research contributions investigating the interplay between trade, offshoring and/or labor market rigidities. Amongst studies that are part of the growing literature on labor-market outcomes of offshoring and trade to which our paper is broadly related, we will only cover more influential contributions. Dutt et al. (2009) investigate the relationship between trade and unemployment in a trade-theoretic setting comprising comparative advantage based on relative factor endowment and productivity differences between countries. They rely on a setup with labor and capital endowments to identify unemployment effects of trade in the presence of labor-market search frictions. Their empirical application provides strong support of a negative relationship between unemployment and trade openness, which the authors take as evidence of that their Ricardian productivity-based prediction dominates the one driven by Heckscher-Ohlin factor-proportions theory. Notably, their result may support predictions of factor-proportions theory based on unskilled and skilled labor endowments (see Moore and Ranjan, 2005).

Mitra and Ranjan (2010) examine offshoring effects on unemployment in a trade-theoretic setting where search frictions prevail in the labor market. Their model captures a so-called productivity effect that favors offshoring producers in the labor-intensive industry, increasing the domestic demand for unskilled labor on the margin.[4] They also reveal that the productivity effect works through a wage-raising effect, as in Grossman and Rossi-Hansberg (2008), as well as through an employment-enhancing effect. Furthermore, the authors show that the unemployment impact of offshoring becomes ambiguous once intersectoral impediments to labor mobility are taken into account. This outcome is coherent with studies on the unemployment impact of trade showing that, once sectoral and international asymmetries in search frictions between employers and unemployed labor are considered, predictions based on traditional trade-theoretic fundaments may be overturned (see, e.g., Davidson, Martin and Matusz, 1999). From this perspective, Moore and Ranjan (2005) provide an important contribution linking the impact of search

[4] Grossman and Rossi-Hansberg (2008) identify this effect in a setting where all industries offshore the same range of job tasks. Prior formal evidence showing that offshoring in the labor-intensive industry may benefit unskilled workers include Arndt (1997), Egger and Falkinger (2003), Jones and Kierzkowski (1990, 2001) and Kohler (2004a, 2004b).

frictions on labor-market adjustments from trade to labor-market institutions. They show that, by raising the reservation utility of workers, labor-market rigidities enforce the unemployment effect of trade and reduce its impact on the skill premium.

Egger and Kreikemeier (2008) introduce efficiency wages in a fragmentation model à la Jones (2000) and Jones and Kierzkowski (2001). In their setting, the wage that firms need to pay to extract normal effort from workers is decreasing in the unemployment of labor with the same skills. Unskilled workers' conception of a fair wage influences the effort with which they perform their job. A more egalitarian system thereby generates a lower skill premium and larger unemployment. The authors provide an alternative story to the one told by Moore and Ranjan (2005) in that labor-market adjustments from globalization affect unemployment to a larger extent in economic systems where workers are more concerned with fairness. They emphasize the central impact of production structure in determining labor-market outcomes of offshoring, showing that a relocation of production from the labor-intensive sector may mitigate unemployment in the unskilled labor market and lower the skill premium if overall home production is sufficiently skill-intensive. Their model captures that offshoring gives rise to offsetting effects in the unskilled labor market, highlighting the beneficial effect incurred from an expansion of the labor-intensive industry.

Keushnigg and Ribi (2009) provide a model of the welfare state's impact on a high-wage country's offshoring of labor-intensive production parts to a low-wage country. The authors investigate how the provision of unemployment insurance and tax policy regulation influences the offshoring incentives of producers. Their primary contribution lies in identifying optimal insurance in the presence of uncertainty and risk triggered by adverse labor-market effects of offshoring. Unemployment insurance triggers a reservation wage that raises unskilled labor costs, reinforcing producer gains from offshoring. The authors show that the government can reduce the income risk of unskilled labor without enhancing producers' offshoring incentives by reducing their income taxes. This policy functions as a wage subsidy that may redistribute offshoring gains in a Pareto-improving manner if financed by a tax increase on skilled worker earnings.

Two recent contributions by Wright (2011) and Kohler and Wrona (2012) investigate detailed trade-theoretic mechanisms through which job task offshoring affects employment when search frictions and/or efficiency wages are incorporated into the Grossman and Rossi-Hansberg (2008) model. Common for these papers, that take different routes to identify the labor-market impact of job task offshoring, is that their primary focus is placed on trade-theoretic underpinnings of the relationship between offshoring and unemployment. Kohler and Wrona (2012) identify a direct unemployment effect from relocating a broader range of job tasks (a worker displacement effect) and an employment effect from deepening offshoring of already relocated tasks (a job creation effect). The authors reveal that these counteracting forces may create a non-monotonic relationship between job task offshoring and unemployment, where the worker displacement effect dominates at an early stage and the job creation effect dominates at a later stage when offshoring has had a more profound domestic market impact.

Wright (2011) builds on the Grossman and Rossi-Hansberg (2008) model to derive testable implications that he investigates using an empirical application for the US manufacturing sector. Besides identifying that offshoring gives rise to a worker displacement effect and a job creation effect, he also finds that the relocation of job tasks affects employment through factor and task substitution effects. The factor substitution effect captures that offshoring leads to price alterations that feed onto the low-skill wage determination, leaving unskilled workers worse off. The task redistribution effect, which stems from the author's incorporation of task specificity into the labor-demand function, works to increase unemployment in the unskilled labor market. The empirical application of the model provides

support of that task offshoring creates worker displacement and job creation effects, revealing that the latter effect grows as offshoring progresses. Furthermore, the empirical results show that offshoring has reduced the employment of unskilled workers and raised the employment of skilled workers in the U.S. manufacturing sector.

3. The Model

Our version of Grossman and Rossi-Hansberg's (2008) job task offshoring model takes the form of a modified 2×2×2 Hecksher-Ohlin setting that allows for international labor productivity differences. A skill-abundant home country with social insurance offshores low-skill tasks to a labor-abundant foreign country. Production in the two industries (x, y) takes place under constant returns to scale. Goods markets are characterized by perfect competition. The two production factors, which are used to produce each good, take the form of unskilled and skilled labor (L,H). Production in industry x is assumed to be skill-intensive. In the following description, f and j depicts production factor and industry. Foreign country variables are denoted by asterisk.

A continuum of L- and H-tasks needs to be performed to complete the production of one unit of either good. To simplify without loss of generality, this f-task continuum is normalized to one. A producer can vary the labor input with which required tasks are performed, carrying out tasks at different intensities. The f-task intensity is measured by the f-labor input used to perform one f-task. Since the f-task continuum used to produce one unit of a good equals one, this implies that the f-task intensity equals the unit f-labor input of production.

The home country may have superior labor productivity if its provision of health insurance raises the health status of the labor force. This productivity effect, which is assumed to be Hicks-neutral, is captured by the parameter $\pi \geq 1$ that is defined as an inverse measure of labor use. While the assumption of a symmetric productivity effect is admittedly restrictive, it enables us to introduce a productivity effect of insurance without altering the fundamental mechanisms of our standard Heckscher-Ohlin setting. This setup could for example be consistent with a scenario where unskilled and skilled workers use health insurance to the same extent. From this perspective, we argue that the assumption is reasonable given our social insurance formulation of a general coverage across citizens.

Producers pay for the social insurance coverage of their employees, implying that unit labor costs exceed wages. Without restricting the cost incidence of insurance, this assumption allows us to capture the direct cost effect of insurance on domestic producer conditions. The cost for f-worker insurance coverage is captured by the parameter $\lambda_f \geq 1$, which is defined as a surcharge levy proportional to the f-wage. Letting w_f denote the (actual) f-wage, this implies that home producers face domestic labor costs ($\lambda_L w_L$, $\lambda_H w_H$).[5] We allow for a direct link between the cost and (general) coverage of f-worker insurance as it provides a useful means to illustrate cost-redistributive effects stemming from insurance design. In insurance systems incorporating a cost-coverage link, producer decisions may be distorted in favor of labor with lower insurance levies if $\lambda_L \neq \lambda_H$.[6] We will henceforth refer to this insurance design as our baseline specification. Intuitively, it can describe economic systems where employers rely on private insurance provision. In economic systems incorporating public insurance, producers instead typically face the same proportional levies (in form of common social security charges) for all employees. We formalize this alternative specification using a common insurance surcharge $\lambda = \lambda_L = \lambda_H$. The alternative insurance design can give rise to a

[5] In our general-equilibrium context, this specification is consistent with the existence of a compensation effect through which raised insurance costs lead to wage reductions. See, amongst others, Gruber and Krueger (1991) and Gruber (1994) for evidence on this effect.

[6] Implications for the wage determination in each labor market, which hinges on current labor-market conditions, and resulting labor-cost effects will be outlined later in this section.

cost-redistributive effect if the insurance coverage differs between labor markets. In the foreign country, labor costs take the form of market wages (w_L^*, w_H^*).

To clarify our exposition without altering the qualitative results of the model, we rely on the simplifying assumption of representative workers. This setup allows us to identify insurance effects, in a way that can be intuitively interpreted as describing the on-average impact on each labour market, without adding unnecessary complexities by introducing worker sub-categories. Our formalization captures stylized labor-market effects through the (partial) work leave of representative workers and, to be coherent with the model's intuitive interpretation, the (proportional) *f*-labor supply reduction is interchangeably referred to as *f*-labor unemployment.

The provision of unemployment insurance triggers a reservation wage, introducing a downward wage boundary at the income compensation level. In our simplified setting, representative workers are only concerned with their income returns and do not differentiate between being employed and unemployed. This implies that the labor supply, which otherwise is perfectly inelastic, becomes perfectly elastic at the reservation wage. We define generous unemployment insurance through its impact on labor markets, giving rise to a binding reservation wage in at least one labor market. A worker receives the same income compensation through health and unemployment insurance. Health insurance is assumed to be in demand even if the market wage exceeds the income benefit from insurance. This assumption can be motivated on the grounds that workers acquire long-run gains from health insurance in form of a higher (total) income in their high-productivity state and/or non-pecuniary health benefits. To simplify the exposition, in coherence with the Hicks-neutral productivity effect of health insurance, the (proportional) work reduction due to sickness leave is assumed to be symmetric across labor markets.

The cost of *f*-worker insurance is specified by the function *g:*

$$\lambda_f = g(\psi_f^{hi}, \psi_f^{ui}, \omega_f), \quad f = L, H, \tag{1}$$

where the *hi* and *ui* superscript denotes health and unemployment insurance, ψ_f is the (proportional) work reduction in the *f*-labor market and ω_f is the *f*-worker income remuneration from insurance.[7] It is assumed that unemployment and health insurance provides mutually exclusive income compensation and that income loss is compensated through the appropriate insurance. Insurance boundaries are thereby clearly defined, leading to a total *f*-labor supply reduction equal to $\psi_f = \psi_f^{hi} + \psi_f^{ui}$. Baseline insurance regulation stipulates that the *f*-worker insurance cost λ_f is directly linked to the *f*-worker insurance coverage (ψ_f, ω_f). With an alternative insurance regulation, *g* is generalized to incorporate a unified cost link to the overall insurance coverage $(\psi_L, \psi_H, \omega_L, \omega_H)$. As unemployment insurance only pertains to labor at the reservation wage, for which the unemployment level is uniquely determined under current labor-market conditions, and the sickness leave of workers is exogenously determined, *g* is a degenerate function with a value unique to the social insurance system.

A representative *f*-worker's income equals the sum of his wage earnings $w_f(1-\psi_f)$ and insurance benefits $\omega_f\psi_f$. We let the representative *f*-worker's income remuneration from insurance constitute a fraction of his prior wage earnings. This fraction, which is predetermined by insurance design, is assumed to be equivalent for unskilled and skilled labor. Our setup, which appropriately describes the income compensation often paid to workers through social insurance in practice, provides a simple mechanism through which labor-market adjustments from globalization can affect unemployment.

[7] The specification can easily be extended to include additional costs of social insurance provision without altering the model's qualitative results.

The cost burden of insurance depends on the employment of healthy labor. The labor supply is perfectly inelastic with full employment of healthy labor, implying that the full cost burden falls on workers who experience a wage reduction that exactly compensates for the cost of (health) insurance. This compensation effect plays a key role in determining wage formation in responsive labor markets. The labor supply is perfectly elastic with unemployment of healthy labor, implying that the full cost burden falls on producers. This cost-enhancing effect introduces a one-to-one relationship between insurance coverage and labor costs (specified by insurance design). Our outcomes highlight that the cost impact of insurance on producer conditions should be examined in the current labor-market context to be properly identified.

The offshoring technology to relocate each *L*-task is available to producers. *L*-tasks are indexed by i in order of increasing offshoring costs and, since the continuum of required *L*-tasks is normalized to one, $i \in [0,1]$. The offshoring cost of task i depends on the cost composite $\beta t(i) \geq 1$, which consists of a common component β (that captures general changes in offshoring costs) and a task-specific component $t(i)$.[8] It is assumed that $t(i)$ is a function that is continuously differentiable and strictly increasing in i. To simplify, offshoring costs are measured in terms of foreign labor use. Letting a_{Lj} depict the unit *f*-labor input prescribed by home producers' industry-j technology, this implies that they require $w_L^* \beta t(i) a_{Lj}$ units of foreign labor to perform task i offshore. Denoting the *L*-task that is just profitable to offshore on the margin by I, the fact that tasks are indexed in order of increasing offshoring costs implies that home producers perform the first I *L*-tasks offshore and the last 1-I *L*-tasks at home. The marginal task I is as costly to perform at home as offshore:[9]

$$\lambda_L w_L / \pi = w_L^* \beta t(I) \tag{2}$$

where $I > 0$ with *L*-task offshoring. The cost for insurance coverage is assumed to exceed the productivity effect of insurance ($\lambda_f \geq \pi$ for $f = L,H$). When producers carry the full cost burden of insurance, this implies that insurance provision expands the range of tasks performed offshore. When workers carry the full cost burden of insurance, insurance provision that introduces a productivity effect instead sustains the domestic performance of a broader range of *L*-tasks. While these outcomes illustrate extreme offshoring implications of insurance provision from a real-world perspective, they highlight that offshoring is not triggered by social insurance per se.

A good's price equals its unit cost of production under perfect competition, implying that producers make zero profits. Home producers in industry j face the zero-profit condition:

$$p_j = \lambda_L w_L (1 - I) a_{Lj} / \pi + w_L^* a_{Lj} \beta \int_0^I t(i) di + + \lambda_H w_H a_{Hj} / \pi, \tag{3}$$

where p_j is the price of good j. The three terms on the left-hand side of (9) are unit costs of production paid for *L*-tasks performed at home, *L*-tasks performed offshore and (domestically performed) *H*-tasks. Solving (2) for w_L^*, inserting the obtained expression into (3), and simplifying the terms yields:

$$p_j = \lambda_L w_L \Omega(I) a_{Lj} / \pi + \lambda_H w_H a_{Hj} / \pi, \tag{4}$$

$$\Omega(I) = 1 - I + \int_0^I t(i) di / t(I), \;\; \Omega(I) \leq 1,$$

[8] Offshoring costs can comprise any relocation cost such as legal, search and negotiation costs incurred from establishing new production networks and transmit/transport costs of the task's output.

[9] Note that this expression, which relies on the assumption of international labor-productivity differences, contrasts to that specified by Grossman and Rossi-Hansberg (2008) for international technology differences (since firms use their own technology). The author thanks Esteban Rossi-Hansberg for pointing this out.

where the first term on the left-hand side captures the unit *L*-labor cost of production, with $\Omega(I) < 1$ comprising the (proportional) cost reduction attained on offshore *L*-tasks. This parameter is strictly decreasing in *I* for $I > 0$, [10] implying that a larger cost gain is incurred with a broader range of offshored tasks. To simplify, we use the price of good *x* as numeraire and let *p* depict the absolute and relative price of good *y*.

To home producers in industry *j*, unit labor inputs (a_{Lj}, a_{Hj}) and the range of offshored *L*-tasks (*I*) are choice variables. Their cost-minimizing skill ratio a_{Hj}/a_{Lj} is chosen with respect to the relative (average) *H*-labor cost $\lambda_H w_H/\lambda_L w_L \Omega(I)$. A binding reservation wage in the *f*-labor market raises the relative cost of *f*-labor, reducing the employment share of the factor in each industry.

Foreign producers in industry *j* face the zero-profit condition:

$$p_j^* = w_L^* a_{Lj}^* + w_H^* a_{Hj}^*, \tag{5}$$

where p_j^* is the foreign price of good *j* and (a_{Lj}^*, a_{Hj}^*) are unit labor inputs in production. Their cost-minimizing skill ratio a_{Hj}^*/a_{Lj}^* is chosen with respect to the relative *H*-labor cost (market price) w_H^*/w_L^*. The *L*-labor demand is increasing in the range of *L*-tasks offshored to the country, placing an upward pressure on the *L*-wage. The relative *H*-labor cost is reduced as a consequence, favoring the employment of *H*-labor in each industry.

In the home country, demand equals (voluntary) supply in each labor market:

$$(1-I)(a_{Lx}/\pi)x + (1-I)(a_{Ly}/\pi)y = (1-\psi_L)L;\ a_{Lx}x + a_{Ly}y = \pi(1-\psi_L)L/(1-I) \tag{6}$$

$$(a_{Hx}/\pi)x + (a_{Hy}/\pi)y = (1-\psi_H)H;\ a_{Hx}x + a_{Hy}y = \pi(1-\psi_H)H, \tag{7}$$

where *L* and *H* denotes the country's endowment of unskilled and skilled labor. Offshoring home producers' demand domestic *L*-labor to carry out task *I* to 1, implying that only a proportion (1-*I*) of their required *L*-tasks is domestically performed. In providing home producers' with access to foreign *L*-labor resources, offshoring functions as an expansion of the domestic effective *L*-labor supply. Insurance provision affects the effective labor supply in (6) and (7) positively through its productivity effect and negatively through its labor-supply effect. The overall impact of social insurance is thereby ambiguous and more likely to be positive in a labor market where the market wage exceeds the income remuneration from insurance.

In the foreign country, demand equals supply in each labor market:

$$a_{Lx}^* x^* + a_{Ly}^* y^* + (a_{Lx}x + a_{Ly}y)\beta\int_0^I t(i)di = L^*, \tag{8}$$

$$a_{Hx}^* x^* + a_{Hy}^* y^* = H^*. \tag{9}$$

The three terms on the left-hand side of (8) capture the *L*-labor demand of indigenous industry-*x* producers, indigenous industry-*y* producers and offshoring home producers in industry *x* and *y* (that carry out task 0 to *I* in the country). In the foreign *H*-labor market, all workers are employed by indigenous producers.

Using (6) and (7) to solve for the home country's output of each good yield:

$$x = \frac{\pi(a_{Ly}(1-\psi_H)H - a_{Hy}(1-\psi_L)L/(1-I))}{\Delta_a}, \tag{10}$$

$$y = \frac{\pi(a_{Hx}(1-\psi_L)L/(1-I) - a_{Lx}(1-\psi_H)H)}{\Delta_a}, \tag{11}$$

[10] Formally, the derivative of Ω w.r.t. *I* equals $d\Omega/dI = -\left(\left(\int_0^I t(i)di\right)/t^2(I)\right)dt/dI$.

$$\Delta_a = a_{Hx}a_{Ly} - a_{Hy}a_{Lx},$$

where $\Delta_a > 0$ as industry-x production is skill-intensive ($a_{Hx}/a_{Lx} > a_{Hy}/a_{Ly}$). The numerators of these output equations are positive, which can be seen if noting that the country's relative factor endowment available for production lies in between its relative factor use in each industry, $a_{Hx}/((1-I)a_{Lx}) \geq ((1-\psi_H)H)/((1-\psi_L)L) \geq a_{Hy}/((1-I)a_{Ly})$. L-task offshoring favors the labor-intensive industry as its efficiency gains falls disproportionately on production with a relatively large employment of L-labor. Social insurance influences domestic production opportunities positively through its productivity effect and negatively through its labor-supply effects. For this reason, an insurance system that provides generous unemployment insurance is more likely to generate economic decline. Asymmetric labor-supply effects of insurance favor production in the industry with an intensive use of the factor displaying starker work participation. In our incomplete-specialization setting, we set aside the possibility that this could render production in one industry unprofitable (and lead to extreme unemployment of the factor used intensively in that production).

Using (8) and (9) to solve for the foreign country's output of each good, inserting the home country's effective L-labor supply equivalent from (6) into the obtained expressions, gives:

$$x^* = \frac{a^*_{Ly}H^* - a^*_{Hy}L^* + \left(\pi(1-\psi_L)L/(1-I)\right)a^*_{HY}\beta\int_0^I t(i)di}{\Delta^*_a}, \tag{12}$$

$$y^* = \frac{a^*_{Hx}L^* - a^*_{Lx}H^* - \left(\pi(1-\psi_L)L/(1-I)\right)a^*_{Hx}\beta\int_0^I t(i)di}{\Delta^*_a}, \tag{13}$$

$$\Delta^*_a = a^*_{Hx}a^*_{Ly} - a^*_{Hy}a^*_{Lx},$$

where the denominators are positive as production in industry x is skill-intensive. The numerators of these output expressions are also positive, which can be verified by the fact that the relative factor supply employed in indigenous production lies in between the relative factor use in each indigenous industry's production, $a_{Hx}{}^*/a_{Lx}{}^* \geq H^*/(L^* - (\pi(1-\psi_L)L/(1-I))\beta\int_0^I t(i)di) \geq a_{Hy}{}^*/a_{Ly}{}^*$. A broader range of tasks offshored to the country intensifies the demand for L-labor, increasing the relative H-labor employment in indigenous production, which favors the foreign country's skill-intensive production.

3.1 Trade equilibrium

In the 2×2×2 Hecksher-Ohlin setting, countries that open up to trade become specialized in production using their abundant factor intensively, forming an international exchange according to comparative advantage. Through Stolper-Samuelson reasoning, whereby this process raises the relative demand for a country's abundant factor, trade increases the abundant factor return and decreases the scarce factor return. The incorporation of job task offshoring into the model leads to market price adjustments while that of social insurance can drive a wedge between domestic factor prices and costs. Instead of introducing standard factor-price equalization, this implies that labor-market adjustments to trade leads to adjusted factor-cost equalization in our version of the model:[11]

[11] These expressions differ from those of adjusted factor-price equalization in the underlying model (Grossman and Rossi-Hansberg 2008, p. 1989) in that insurance surcharges and labor-productivity differences are included instead of inherent technology differences.

$$\lambda_L w_L \Omega(I)/\pi = w_L^*, \tag{14}$$

$$\lambda_H w_H/\pi = w_H^*. \tag{15}$$

Since producers' cost-minimizing decisions are made with respect to relative *H*-labor costs ($\lambda_H w_H/\lambda_L w_L \Omega(I)$, w_H^*/w_L^*), this implies that domestic and foreign production in an industry takes place at identical factor proportions in trade equilibrium. An international *f*-labor cost gap that prevails in trade equilibrium thereby reflects the superior productivity of labor in the home country, $a_{fj}\pi = a_{fj}^*$.

In the home country, adjustments from trade raise the *H*-wage and reduce the *L*-wage if labor markets are responsive. Once the reservation wage becomes binding, these adjustments influence the unemployment. Since adverse trade effects occur in the country's *L*-labor market, trade can make *L*-workers more dependent on unemployment insurance. Asymmetric labor-supply effects of insurance triggered by trade thereby raises the relative *H*-labor endowment available for home production. This implies that, while trade expands the country's skill-intensive industry, it leads to an overspecialization of production with an insurance design that provides generous income remuneration through (unemployment) insurance. The tendency is reinforced with baseline insurance regulation.

In availing home producers access to foreign low-cost labor, *L*-task offshoring imposes a similar impact to trade on relative goods prices. This gives rise to Stolper-Samuelson type effects in the countries' factor markets (relative-price effects). In addition, *L*-task offshoring introduces a marginal cost advantage for home producers in the labor-intensive industry working to the benefit of indigenous *L*-labor (the productivity effect). Offshoring may also trigger wage-restrictive, cost-enhancing, cost-redistributive, compensation and labor-supply effects of insurance that will be investigated in detail in the coming subsection.

Standard Stolper-Samuelson effects of trade work through foreign labor markets, raising the country's *L*-wage and reducing its *H*-wage. *L*-task offshoring triggers the same type of relative-price effects by introducing fiercer competition for foreign *L*-labor. Insofar as social insurance provision introduces an artificially high *L*-wage at home, trade raises the foreign equilibrium *L*-wage through (adjusted) factor-cost equalization. By increasing domestic *L*-labor costs, a generous unemployment insurance expands the offshored range of *L*-tasks (through (2)). In turn, this intensifies the competition for foreign *L*-labor and places an upward pressure on the foreign *L*-wage.

Combining (2) and (14), using the Ω-equivalent, yields:

$$1 = \beta\left((1-I)\iota(I) + \int_0^I \iota(i)di\right). \tag{16}$$

It can be shown that the parenthesis value increases in *I*,[12] confirming that a general reduction in offshoring costs (captured by a β-decline) expands the range of offshored *L*-tasks.

World output equations are added up from national output equations for good *x* (10, 12) and good *y* (11, 13), using that $\pi a_{fj} = a_{fj}^*$ holds in trade equilibrium, the β-equivalent from (16) and the Ω-equivalent:

$$x + x^* = \frac{1}{\Delta_a}\left(\left(\pi(1-\psi_H)H + \frac{H^*}{\pi}\right)a_{Ly} - \left(\frac{\pi-1}{1-I} - \frac{1}{\Omega}\right)(1-\psi_L)L + \frac{L^*}{\pi}\right)a_{Hy}, \tag{17}$$

$$y + y^* = \frac{1}{\Delta_a}\left(\left(\left(\frac{\pi-1}{1-I} + \frac{1}{\Omega}\right)(1-\psi_L)L + \frac{L^*}{\pi}\right)a_{Hx} - \left(\pi(1-\psi_H)H + \frac{H^*}{\pi}\right)a_{Lx}\right). \tag{18}$$

[12] The parenthesis derivative with respect to *I* equals $(1\text{-}I)d\iota/dI > 0$.

Using the standard assumptions that demand is homothetic and the relative world demand for a good is decreasing in its relative price, a raised (lowered) relative world supply of the skill-intensive good leads to worsened (improved) terms-of-trade for the home country and improved (worsened) terms-of-trade for the foreign country. As a consequence, an insurance design that incorporates generous unemployment insurance worsens the home country's terms-of-trade and does so to a larger extent if it stipulates a baseline specification. This results in a negative welfare effect that adds onto the welfare effect of insurance working through its impact on domestic production opportunities. The terms-of-trade effect of insurance is beneficial for the foreign country, reinforcing its welfare gains from trade. In contrast, the terms-of-trade (relative-price) effect of offshoring favors the home country at the foreign country's expense. These terms-of-trade effects become negligible if the home country is small.

3.2 Decomposed Wage Effects of Job Task Offshoring

In this subsection, we use Grossman and Rossi-Hansberg's (2008) comparative static approach to identify decomposed wage effects of a general improvement in offshoring technology (in the form of a β-reduction). The approach allows us to extract relative-price, productivity and insurance effects of offshoring. Of course, offshoring has no impact on the actual wage in an unresponsive labor market. The exercise to establish market-wage effects of offshoring can be useful even in this case, however, since it indicates under what conditions offshoring work to reinforce and counteract labor-market rigidities.

Decomposed wage effects are derived by totally differentiating zero-profit condition (3) in the production of each good and labor-market expressions (6, 7) in response to a marginal decline in β, treating p, Ω, I, ψ_L, λ_L and λ_H as (momentarily) exogenous. Using this method to solve for proportional low-skill and high-skill wage alterations in the yield:

$$\frac{dw_L}{w_L} = \frac{1}{\theta_{Ly}}\left(\frac{1}{p} + \frac{\theta_{Hy}\gamma_a}{\theta_{Ly}}\right)dp - \frac{d\Omega}{\Omega} + \frac{\theta_{Hy}\gamma_a\delta_{Ly}}{\theta_{Ly}\sigma_y}\left(\frac{dI}{1-I} - \frac{d\psi_L}{1-\psi_L}\right) - \frac{d\lambda_L}{\lambda_L}, \tag{19}$$

$$\frac{dw_H}{w_H} = -\frac{\gamma_a}{\theta_{Ly}}dp - \frac{d\lambda_H}{\lambda_H}, \tag{20}$$

$$\gamma_a = \left(\frac{a_{Hx}/a_{Lx}}{a_{Hy}/a_{Ly}} - 1\right)^{-1},$$

where θ_{fy} is the f-labor cost share in industry-y production, γ_a is an inverse measure of the relative skill ratio in industry x (that exceeds zero as the industry is skill-intensive), δ_{fy} is the f-labor share employed in industry-y production and σ_y is the demand elasticity of good y (that takes a negative value). A marginal decline in β raises the range of offshored tasks ($dI > 0$), reducing the relative price of the labor-intensive good ($dp < 0$), lowering production costs of tasks produced offshore ($d\Omega < 0$) and giving rise to (potential) unemployment in the L-labor market ($d\psi_L \geq 0$). Since the full cost burden of insurance falls on workers in a responsive f-labor market, a general improvement in offshoring technology may also affect f-wage formation through a compensation effect $d\lambda_f/\lambda_f$. Since the insurance coverage is unaffected by offshoring in a responsive labor market, the compensation effect always equals zero when workers are covered through baseline insurance. However, an alternative insurance design can give rise non-zero compensation effects by triggering cost redistribution across labor markets.

The relative-price effect of offshoring, which is captured by the dp-term, impacts negatively (positively) on the L-wage (H-wage). The productivity effect of offshoring is captured by the $d\Omega/\Omega$-term. This effect indirectly enhances

the *L*-labor demand, resulting in a positive impact on the *L*-wage. Notably, it captures a cost reduction on already offshored tasks that is unaffected by insurance provision. The direct employment effect of offshoring, which is captured by the dI/(1-I)-term, cancels out in a responsive *L*-labor market since producers reorganize their production in response to altered factor prices (in our incomplete specialization Heckscher-Ohlin setting). As a consequence, no employment reduction is triggered by offshoring in (19). The unemployment effect of offshoring is captured by the $d\psi_L/(1-\psi_L)$-term, which equals zero in a responsive labor market. To investigate the (theoretical) market-wage impact of offshoring in an unresponsive labor market, we note that the employment effect is directly translated into an unemployment effect in our setting where workers seek income compensation through unemployment insurance. This way, the employment reduction of offshoring gives rise to direct unemployment with generous income remuneration through (unemployment) insurance. This effect is our model's version of the worker displacement effect identified in Wright (2011) and Kohler and Wrona (2012).

Our decomposition of wage effects reveals that offshoring can influence a responsive *L*-labor market through relative-price and productivity effects. Offshoring may therefore impact negatively or positively on the *L*-wage depending on the relative impact of the relative-price effect and productivity effect in (19). If the relative-price effect exceeds the productivity effect, offshoring contributes to depress the *L*-wage. Once the reservation wage becomes binding under this scenario, further offshoring is translated into raised unemployment. This increase, which stems from a direct unemployment effect of reducing the range of domestically performed tasks (the worker displacement effect) and an indirect unemployment effect reflecting a price-induced demand reduction for *L*-labor that jointly outweighs the employment effect due to reduced offshoring costs, implies that a (possibly non-linear) positive relationship prevails between the range of offshored *L*-tasks and unemployment in a unresponsive *L*-labor market. As a consequence, the cost-benefits of offshoring does not give rise to (our model's version of) a job creation effect stark enough to fully offset adverse offshoring effects in the *L*-labor market. Under this scenario, it is clear that offshoring can segment labor-market rigidities generated by the provision of generous unemployment insurance.

If the relative-price effect is exceeded by the productivity effect, offshoring raises the wage in a responsive *L*-labor market. In an unresponsive *L*-labor market, offshoring that gives rise to a job creation effect outweighing the price-induced unemployment increase works to counteract the worker displacement effect. The outcome indicates that offshoring does not necessarily worsen unemployment with an insurance design that provides generous income remuneration through (unemployment) insurance. Indeed, offshoring may even lead to an unemployment reduction if the job creation effect outweighs other effects of offshoring. This way, offshoring can contribute to decrease the *L*-worker dependency on generous unemployment insurance.

Our decomposition of wage effects furthermore shows that an improved offshoring technology may give rise to relative-price and compensation effects in a responsive *H*-labor market. There is always a positive relative-price effect while a negative compensation effect only exists if offshoring generates *L*-labor unemployment and workers are covered through the alternative form of insurance. The relative-price effect may be exceeded by the compensation effect, implying that offshoring can introduce an *H*-wage reduction with an insurance design that provides generous income compensation and incorporates a cost-redistributive feature. Under this scenario, *L*-worker incomes are protected from adverse offshoring effects through insurance while *H*-worker incomes decline with offshoring because of insurance provision. Once the market wage reaches the reservation wage in the *H*-labor market, the full cost burden of insurance is shifted unto producers. In an unresponsive *H*-labor market, price-induced adjustments to offshoring reduce the *H*-labor dependency on (unemployment) insurance.

4. Conclusions

We provide a simple model that incorporates social insurance into a Grossman and Rossi-Hansberg (2008) model of job task offshoring. Our trade theoretic setting is a Heckscher-Ohlin version of the model modified to allow for (Hicks-neutral) labor productivity differences. In line with the aim of providing a description that is generally applicable to Western economic systems, our conceptualization of social insurance defines its impact on domestic producer conditions. This way, we can identify productivity, wage-restrictive, compensation, cost-enhancing, cost-redistributive and labor-supply effects of insurance. First, home workers can become more productive if the health status of the labor force is improved by the (general) provision of health insurance. Second, generous unemployment insurance can give rise to binding reservation wages. Third, the cost burden of insurance may fall on producers or workers depending on whether the reservation wage is binding. In a responsive labor market, where workers carry the cost burden of insurance, employers are fully compensated for insurance cost payments through wage reductions. In an unresponsive labor market, where producers carry the cost burden of insurance, insurance provision is directly translated into raised labor costs. Fourth, an insurance design that stipulates a cost-coverage link may distort producer decisions in favor of workers that carry lower insurance levies. Fifth, voluntary unemployment is triggered once the reservation wage becomes binding in a labor market. Our general conceptualization of social insurance allows us to focus on the role of insurance design, which sets our contribution apart from related research.

The productivity, wage-restrictive and cost-enhancing effects of insurance influence producers' offshored range of tasks. The cost-enhancing effect is assumed to exceed the productivity effect, reinforcing producers' offshoring incentives. An insurance design that provides high enough unemployment benefits to introduce a binding reservation wage in the unskilled labor market thereby expands the offshored range of tasks. In contrast, an insurance design that triggers a productivity effect but does not provide generous unemployment insurance sustains the domestic performance of a broader range of tasks because workers carry the full cost burden of insurance. These outcomes highlight that a country's insurance provision does not necessarily raise its producers' offshoring incentives. Indeed, social insurance that raises the health status of the labor force without distorting the work incentives of unskilled labor can even contribute to sustain more low-skill tasks in home production.

The home country's insurance provision influences its effective labor supplies positively through the productivity effect and negatively through the labor-supply effects while home producers' offshoring of low-skill tasks functions as an expansion of the country's effective unskilled labor supply. Insurance provision can thereby reinforce or counteract the beneficial offshoring effect on domestic production opportunities. An insurance design that incorporates generous unemployment insurance is more likely to counteract favorable domestic output effects of offshoring. Furthermore, asymmetric labor-supply effects of insurance alter the domestic production structure in favor of the industry using labor with starker work participation intensively. Since a person's income remuneration from insurance constitutes a fraction of his prior wage earnings, and adverse wage effects from trade occurs in the unskilled labor market, trade gives rise to asymmetric labor-supply effects with generous unemployment insurance provision. This way, social insurance can raise the home country's relative endowment of skilled labor available for production and raise the home country's relative supply of skill-intensive goods in trade equilibrium. As a consequence, generous unemployment insurance introduces a domestic overspecialization from trade. The home country's terms-of-trade are worsened as a result, introducing a negative welfare effect adding onto the welfare effect of insurance that works through its impact on domestic production opportunities. This terms-of-trade effect becomes negligible if the home country is small.

We study the effect of insurance design on labor-market impacts of offshoring using Grossman and Rossi-Hansberg's (2008) comparative static approach. The approach enables us to extract decomposed market-wage effects of offshoring, which are directly applicable to responsive labor markets and can be used to identify conditions under which offshoring reinforces and counteracts rigidities in unresponsive labor markets. In a responsive unskilled labor market, offshoring affects wage formation negatively through price-adjustments (the relative-price effect) and positively through cost savings on offshored tasks (the productivity effect). If the relative-price effect exceeds the productivity effect, offshoring gives rise to an adverse wage effect in this labor market. Once the reservation wage becomes binding, further offshoring triggers unemployment. Offshoring can therefore segment labor-market rigidities triggered by generous unemployment insurance.

Offshoring that gives rise to a smaller labor-market impact through price-adjustments than foreign cost savings instead raises the wage in a responsive unskilled labor market. If the relative impact of cost savings is strong enough, offshoring also counteracts unemployment at a binding reservation wage. This way, offshoring may reduce the need for unskilled worker protection and lower the costs of sustaining the social insurance system. This implication, which replicates one of the main findings in Egger and Kreickemeier (2008), stands in stark contrast to the outcomes in the welfare-systems competition literature (see e.g. Sinn 1997, Sinn 2004) where offshoring necessarily increases costs for social insurance provision.

In a responsive skilled labor market, offshoring triggers a positive relative-price effect and may give rise to a negative compensation effect whereby employers recover insurance costs. While the relative-price effect always prevails, the compensation effects is only triggered by offshoring if raised insurance costs from unemployment in the unskilled labor market is partly covered by higher insurance levies for skilled workers. This way, the positive market-induced effect of offshoring can be counteracted with an insurance design that provides generous unemployment benefits and incorporates a cost-redistributive feature. The compensation effect that results in this case may be stark enough to exceed the relative-price effect, resulting in a wage reduction from offshoring in the skilled labor market. Under this scenario, unskilled worker incomes are protected from adverse offshoring effects through insurance while skilled worker incomes decline with offshoring because of insurance provision. That a cost-redistributive feature inherent in insurance design reduces the skill premium by enhancing skilled workers' cost burden of insurance provides a complementary explanation to the one provided in Egger and Kreickemeier (2008), where unskilled workers' demand for a fair wage restricts the offshoring impact on the skill premium in Egalitarian states.

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