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Increasing Resistance to Globalization: The Role of Trade in Tasks[*]

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December 2018

Abstract

We show in this paper that trade in tasks can explain increasing resistance to globalization in industrialized countries. In a traditional trade model of a small open economy, we demonstrate that schooling provides protection against losses from trade if trade increases the relative price of the skill-intensive good. Furthermore, increasing public schooling expenditure may help securing support for trade reform by a majority of voters. However, this conclusion is no longer true, if education provides task-specific skills and trade in tasks makes some of these skills obsolete in the open economy. In this case, increasing public schooling expenditure may be of limited help to secure support for trade reform by a majority of voters, even if the reform is welfare-improving. Our analysis suggests to change the education system to one that provides broader, less-specialized skills in order to facilitate trade reforms. Although such skills may be less productive, they do not become obsolete in the open economy and therefore increase the likelihood that a proposal for a welfare-improving trade reform is successful in a referendum.

Keywords: Resistance to globalization, Trade in tasks, Public education, Majority voting

JEL Classification: F11, F50, D72, I28

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"The education systems in most countries still reflect the industrial era, *[in which]* people owned distinct occupational identities."

— Kai-Ming Cheng (2010)

1 Introduction

There is clear evidence in recent years for increasing resistance to globalization among large parts of voters in industrialized countries, with protests against the *Transatlantic Trade and Investment Partnership* (TTIP) in Western European countries, such as Germany (see *The Economist*, 15 September 2016), or the election of Donald Trump and the vociferous approval of part of the conservative voters in the US for his repeated attacks on the world trading system being prominent examples that have received considerable media attention. Thereby, resentment over globalization is often attributed to an unfair distribution of its merits, prompting the conclusion of several observers that globalization needs to be re-oriented (cf. Piketty, 2016). However, the insight that globalization generates winners and losers is not new and it may therefore come to a surprise that its distributional effects have become such a widespread concern in the last couple of years. An explanation put forward in this paper is that in the era of offshoring winners and losers of globalization are no longer separated by their education level, so that skilled and unskilled workers can be negatively affected, with schooling losing part of its capacity to provide protection against potential losses from trade. In particular, if schooling provides skills that are tailored to the needs of specific tasks, educated workers are vulnerable to finding not an adequate new workplace, when losing their job due to offshoring.[1,2]

To address increasing resistance to globalization and to discuss possible explanations for it, we set up a model of a small open economy with two sectors, producing goods and services, and two factor inputs, associated with skilled and unskilled labor. The supplies of skilled and unskilled labor are endogenous and determined by the schooling decision of households as well as public education spending, which defines an ability threshold that has to be surpassed for acquiring the skills necessary to perform the tasks required for the production of goods. There are two different tasks and education provides specific

[1]Work by Blinder (2006), Blinder and Krueger (2013), and Becker et al. (2013) has shifted attention from worker to job characteristics for explaining the offshorability of tasks. According to their taxonomy, jobs are at risk of being offshored, if the tasks conducted are routine and do not need face-to-face communication, providing an explanation for why jobs of cleaning staff are relatively secure, whereas jobs of radiologists are at risk of being put offshore to India as pointed out by *The Economist*, 19 February, 2004. The notion of trade in tasks was introduced into the theoretical literature on offshoring by Grossman and Rossi-Hansberg (2008).

[2]This argument is particularly important in the context of the Bologna reform of the European university system, which has the clear merit of facilitating mobility of students across borders, but at the same time is often criticized for producing too many highly specialized master programs as pointed out, for instance, by *The Economist*, 4 July, 2007.

skills that are productive in the performance of one but not the other task. This captures in a simple way existing evidence that reallocation of workers between occupations is costly and takes time (see Artuç and McLaren, 2015). Following Spector (2001), we assume that labor input is sector-specific with unskilled labor only used for producing services and skilled labor only used for performing the two tasks in the production of goods. This gives a simple framework for distinguishing the consequences of trade in goods and services, on the one hand, and trade in tasks, on the other hand.

Associating in a first step globalization with trade in goods and services only and assuming that the relative price of goods is higher in the open than the closed economy, there are gains from trade for skilled and losses from trade for unskilled workers, as suggested by the Stolper-Samuelson theorem. This captures in a stylized way the experience of skilled-labor abundant, industrialized countries in the period after the Second World War. The group of skilled workers and thus the group of households benefitting from trade is increased if a welfare-maximizing government optimally adjusts its education policy and increases public schooling expenditure. Allowing for trade in tasks and assuming that one of the two tasks can be imported at a lower cost from abroad reflects the more recent experience of industrialized countries. Furthermore, assuming that it is only revealed after the schooling decision, which task will be imported from abroad, we add uncertainty as an additional factor of globalization that seems empirically important.[3] As a consequence, not only the unskilled but also part of the skilled workers lose from globalization, implying that the gains from trade are confined to an even smaller group of households. However, the gains from trade are larger if trade in tasks is feasible, and these gains are further increased and spread among a larger group of households if the government optimally adjusts its education policy and further increases public schooling expenditure.

In a next step, we add a simple political economy framework that gives the electorate a say on trade policy. For this purpose, we build on the idea of majority voting and assume that a referendum over trade reform is successful only if at least 50 percent of households are better off in the open than the closed economy. Since the referendum takes place after the schooling decision has been made, it constitutes a constraint for the education policy implemented by the government, which is binding because the government would educate a minority of households without the threat that the trade reform can be rejected by the electorate. With trade in goods and services only, the government will increase schooling expenditure to educate a majority of households, leading to *overeducation* from a social planner's point of view. The incentive for the government to deviate from its optimal education policy under autarky only exists, how-

[3]Relying on data from a British household panel survey, Scheve and Slaughter (2004) argue that increasing worker insecurity is an important aspect of globalization. Using German household survey data, Geishecker et al. (2012) find that offshoring to low-income countries is an important factor of rising job loss fears not only among unskilled but also among skilled workers.

ever, if the terms-of-trade effect and thus the gains from openness are sufficiently large to compensate for the resources wasted under excessive schooling.[4]

Extending the model to one that additionally allows for trade in tasks challenges the insight that education policy can be a successful instrument to secure support for free trade by a majority of voters. In particular, if the two tasks are equally important for the production of goods, an increase in public schooling expenditure is not sufficient to make a majority of households better off in the open economy. In this case, a proposal for trade reform will only be successful in the referendum if the schooling system is changed more drastically to one providing less specialized skills that can be used for the performance of both tasks at the cost of lower productivity. In this case, free trade can get support from a majority of the electorate if the government educates more than 50 percent of households, which is attractive irrespective of the size of terms-of-trade effects if the productivity discount from lower specialization is not too large. We also discuss under which conditions the electorate supports the combined schooling plus trade reform. Since workers with high learning abilities will be compensated for the higher education cost under a trade plus schooling reform only if the stimulus of their real wage is strong enough, the terms-of-trade effect must be sufficiently pronounced for the combined reform to get support from a majority of voters. This is not the case for all welfare-increasing reforms. We complement our analysis from the main text by two extensions, in which we analyze the robustness of our results when lifting two restrictive assumptions on offshoring in the benchmark model.

Our analysis builds on a sizable literature that emphasizes the role of endogenous human capital formation for the realization of gains from trade. The first contribution to this literature is attributed to Findlay and Kierzkowski (1983), and their model has been extended to the case of a continuum of abilities by Borsook (1987) and Auer (2015), whereas Cartiglia (1997), and Ranjan (2001) have introduced credit-constraints of households.[5] Janeba (2003) has shifted attention to the role of governments for influencing schooling decisions in an open economy, and Bougheas et al. (2011) impose the rather strong assumption that the government chooses the education level of individual workers. In our setting, the government

[4] We associate overeducation and excessive schooling with public education expenditure above the social optimum. However, it is also possible in our model that skilled workers end up in jobs, which only require unskilled labor input, closely related to the idea of labor market mismatch put forward by the literature looking more specifically at the phenomenon of overeducation (see Freeman, 1976; Duncan and Hoffman, 1981). In their recent report for the European Commission, Flisi et al. (2014) argue that this form of mismatch and the social costs of it will further increase in the European Union in the near future.

[5] Falvey et al. (2010) discuss endogenous skill adjustments to trade liberalization in a Heckscher-Ohlin model and show that some workers who upgrade their skills (in particular, older and less able ones) can lose from trade. Davidson and Sly (2014) point to the role for schooling as a signaling device in a setting with asymmetric information of applicants and firms about the abilities of the former. The lack of information on the producer side prompts firms to pay the average productivity of skilled workers as a remuneration for their labor input, which leads to overeducation because workers with too low abilities choose to be educated. Similar to our analysis, globalization can be an important factor of overeducation in this setting, even though the reasons for overeducation are different in the two approaches.

determines an ability threshold that must be surpassed by households to acquire the necessary skills for performing tasks. However, households above the threshold are free to choose education and they are free to choose the task for which they want to acquire the respective skills.[6]

Furthermore, shedding light on political support for trade reforms, we build on early work by Mayer (1984) who shows how approval of trade policy is linked to factor ownership and how implemented tariff levels are influenced by the distribution of ownership under a median voter approach (see Dutt and Mitra, 2002; Dhingra, 2014, for an empirical assessment). Fernandez and Rodrik (1991) extend the analysis to one with ex ante uncertainty to explain resistance to trade reforms that would have been accepted by a majority of voters after individual gains from trade have been revealed. We consider uncertainty about the effects of trade at the stage of schooling, but assume that the effects are known, when voters decide on the trade reform. This renders provision of specialized skills through public education, while having a positive impact on productivity, an important obstacle to trade liberalization if offshoring makes some of these skills obsolete in the open economy.

Blanchard and Willmann (2011) employ a model with overlapping generations to point out that political steady states under majority voting need not be unique and may result in protectionist and liberal tariff regimes. Their analysis also makes clear that transition from the former to the latter is in principle feasible but may require a strong policy intervention. Blanchard and Willmann (2016b) look at the transitional dynamics and show that in a model with overlapping generations, a terms-of-trade shock may lead to protectionist overshooting in the short run, with trade barriers gradually declining in the aftermath of the shock. Provided that the education system allows human capital formation for a large proportion of households, their dynamic political economy model leads to lower tariffs in the long run. We do not analyze dynamic aspects of trade reforms but instead highlight differences in the perception of voters regarding trade reforms that change the relative prices of goods and service and trade reforms that involve also trade in tasks and make some skills obsolete in the open economy.

Finally, our analysis is also related to a literature discussing the role of compensation for the political support of trade reform (Feenstra and Bhagwati, 1982; Magee, 2003). In a recent paper, Davidson et al. (2007) have addressed this question in a setting with majority voting over compensation and trade liberalization and point out that the order, in which the respective reforms are implemented, matters for the outcome. Similar to them, we also discuss the conditions under which a majority of voters supports the

[6]Chang and Huang (2014) and Chaterjee (2017) analyze strategic education policies in a two country setting, emphasizing that divergence in education systems might be an equilibrium outcome in such an environment. Blanchard and Willmann (2016a) consider a setting with many industries and a continuous set of human capital choices in which education policy shapes the pattern of comparative advantage. In their model the individual gains from trade need not be monotonic and trade can make workers from the middle of the ability distribution worse off, thereby providing an explanation why trade liberalization loses support among voters from the middle class.

combination of two policy reforms, but we do not discuss how the timing of reforms affects our results. Furthermore, in contrast to Davidson et al. (2007) we emphasize the differences between trade in goods and services and trade in tasks for the support of trade reform.

The rest of the paper is organized as follows. In Section 2, we introduce the building blocks of our analysis. In Section 3, we determine the market outcome and discuss the optimal education policy for the closed and a small open economy. In Section 4 we extend our analysis by a political economy framework and determine the support for trade reform by the electorate under majority voting. There, we also discuss the scope of the government to adjust its education policy in order for a proposal of trade liberalization to be successful in a referendum. In Section 5, we consider two extensions of our benchmark model, and the last section concludes with a summary of our results.

2 The model: basics

We consider a model with N one-person households who earn income as production workers and spend this income as consumers for purchasing goods (G) and services (S). Preferences are Cobb-Douglas and for the representative consumer they are given by a utility function of the form

$$U(Z_G, Z_S) = \left(\frac{Z_G}{\gamma}\right)^{\gamma}\left(\frac{Z_S}{1-\gamma}\right)^{1-\gamma}, \qquad \gamma \in (0,1), \tag{1}$$

where Z_j is aggregate consumption of good $j = G, S$. Market demand for good j can be derived by maximizing the utility in Eq. (1) subject to the economy-wide budget constraint and in the Cobb-Douglas case it is given by a constant expenditure share rule:

$$P_G Z_G = \gamma I \quad \text{and} \quad P_S Z_S = (1-\gamma) I, \tag{2}$$

where I is aggregate income, and P_G, P_S are prices of goods and services, respectively. The cost of living price index, which measures how much income must be spent on the optimal consumption bundle to purchase one unit of utility, corresponds to $P \equiv P_G^{\gamma} P_S^{1-\gamma}$.

Goods and services are supplied by competitive industries. The production of goods requires assembling two tasks, X_1 and X_2, using a Cobb-Douglas technology, while production of services requires the input of unskilled labor L:

$$Y_G = \left(\frac{X_1}{\alpha}\right)^{\alpha}\left(\frac{X_2}{1-\alpha}\right)^{1-\alpha}, \qquad Y_S = L_S, \tag{3}$$

where Y_j is output of industry $j = G, S$. Tasks are performed by skilled labor H according to a linear technology: $X_i = H_i$, $i = 1, 2$. The technology assumptions imposed here are akin to those in Spector (2001), with the difference that we add an intermediate production step, which allows us in the open economy to distinguish between trade in goods and services, on the one hand, and trade in tasks, on the other hand.[7] Tasks can either be produced in-house or purchased at arm's length from independent producers at competitive prices.

Maximizing profits of goods and services determines demand for skilled and unskilled labor:

$$\alpha P_G Y_G = P_1 X_1 = w_H^i H_1, \qquad (1-\alpha) P_G Y_G = P_2 X_2 = w_H^i H_2, \qquad P_S Y_S = w_L L, \tag{4}$$

where w_H^i, w_L are skilled and unskilled wages, respectively. Thereby, skilled wages are task-specific, because the mobility of skilled workers between tasks is limited, as outlined below. The price of task i equals the return to skilled labor performing this task: $P_i = w_H^i$. Furthermore, the prices of goods and services can be expressed as functions of skilled and unskilled wages according to :

$$P_G = P_1^{\alpha} P_2^{1-\alpha} = \left(w_H^1\right)^{\alpha} \left(w_H^2\right)^{1-\alpha}, \qquad P_S = w_L, \tag{5}$$

respectively.

The supply of skilled and unskilled labor is endogenous in our model and depends on the schooling decisions of households. Households are borne with one unit of unskilled labor endowment. If successful, schooling transforms one unit of unskilled labor into one unit of skilled labor, with the respective skill acquired by schooling being task-specific and useless for the performance of the other task. However, skilled workers can downgrade and provide unskilled labor input at no extra cost. Households differ in their learning abilities, which are denoted by e and distributed according to a continuously differentiable cumulative distribution function $F(e)$ with support $(0, 1)$. Learning abilities are inversely related to teaching input needed for successful schooling. The teaching input determines a threshold $\hat{e}$ that is common to both tasks and gives a lower ability bound that must be surpassed to learn the skills necessary for task production. Teaching input is provided by the public sector using a fraction $k(\hat{e})$ of the innate unskilled labor endowment of households (and reducing effective labor supply).[8] As long as the market

[7] In the Appendix, we discuss a model variant, in which unskilled labor is used as an additional input for task production.

[8] The schooling model considered here differs from Findlay and Kierzkowski (1983), Kreickemeier (2009), and Bougheas et al. (2011), because the resources devoted to education are endogenous. Egger et al. (2010) consider optimal education spending and assume that public schooling expenditures are financed by a proportional tax on skilled and unskilled labor income. In a static model, this assumption implies that schooling takes place before tax income is generated through production. Our assumption avoids this timing problem, while it captures the important aspect that schooling absorbs resources that could be productively used elsewhere.

promises a skill premium $\omega^i \equiv w_H^i/w_L > 1$, all households with abilities higher than threshold $\hat{e}$ will seek education and become skilled workers. Setting $k(\hat{e}) \equiv 1 - F(\hat{e})$ simplifies notation and has the attractive feature of generating an interior solution with some workers remaining unskilled in equilibrium.

3 Market equilibrium and optimal education policy

3.1 The closed economy

Let us first consider a closed economy, in which the households' education decision equalizes the return on skilled labor input in the production of the two tasks, i.e. $\omega^i = \omega$ for $i = 1, 2$. Furthermore, to ensure that at least some workers choose schooling, goods production must offer a skill premium of $\omega > 1$. Then, noting from Eq. (5) that the skilled wage rate is equal to the price for goods, $w_H = P_G$, whereas the skill premium is equal to the price ratio of goods and services, $\omega = P_G/P_S \equiv \pi$, it follows from Eqs. (2) and (4) that

$$\frac{Z_G}{Z_S} = \frac{\gamma}{1-\gamma}\frac{1}{\pi} = \frac{\gamma}{1-\gamma}\frac{1}{\omega}, \qquad \frac{Y_G}{Y_S} = \frac{H}{L}. \tag{6}$$

Accounting for goods market clearing $Z_j = Y_j$, $j = G, S$ and labor market clearing $H = [1 - F(\hat{e})][1 - k(\hat{e})]$, $L = F(\hat{e})[1 - k(\hat{e})]$, we then obtain an implicit relationship between threshold ability $\hat{e}$ and skill premium ω:

$$\omega = \frac{\gamma}{1-\gamma}\frac{F(\hat{e})}{1 - F(\hat{e})}, \tag{7}$$

with $\lim_{\hat{e}\to 0} \omega = 0$, $\lim_{\hat{e}\to 1} \omega = \infty$, and $d\omega/\hat{e} > 0$.

A benevolent government that aims at maximizing utilitarian welfare will choose a schooling threshold $\hat{e}$ that maximizes real economy-wide income $I/P = N\pi^{-\gamma}\left\{\omega[1 - F(\hat{e})] + F(\hat{e})\right\}[1-k(\hat{e})]$, subject to Eq. (7). For $k(\hat{e}) = 1 - F(\hat{e})$ and $\pi = \omega$, the optimization problem of the government reduces to $\max_{\hat{e}} V(\hat{e})$, where

$$V(\hat{e}) \equiv \frac{F(\hat{e})^{2-\gamma}[1 - F(\hat{e})]^{\gamma}}{\gamma^{\gamma}(1-\gamma)^{1-\gamma}} \tag{8}$$

is per-capita income in the closed economy. The welfare maximizing schooling threshold chosen by the government is then given by the first-order condition

$$V'(\hat{e}) = \frac{V(\hat{e})F'(\hat{e})}{F(\hat{e})[1-F(\hat{e})]}\left\{2(1-F(\hat{e}))-\gamma\right\} = 0, \tag{9}$$

which has a unique interior solution $\hat{e}_a \in (0,1)$ that is implicitly determined by $F(\hat{e}_a) = 1-\gamma/2$. Thereby, subscript a is used to refer to the autarky equilibrium. Due to $\gamma < 1$, we have $F(\hat{e}_a) > 1/2$, so that the economy-wide skilled to unskilled labor ratio H/L chosen by the government is smaller than one and the resources used for schooling $k(\hat{e}) = 1 - F(\hat{e})$ are less than 50 percent of the economy's initial unskilled labor endowment. For $F(\hat{e}_a) = 1-\gamma/2$, we compute $\omega_a = \pi_a = (2-\gamma)/(1-\gamma) > 2$ and utilitarian welfare (per-capita) is given by

$$V(\hat{e}_a) = \frac{(2-\gamma)^{2-\gamma}}{4(1-\gamma)^{1-\gamma}} = \frac{\pi_a^{2-\gamma}}{4(\pi_a-1)} \equiv v(\pi_a). \tag{10}$$

This completes the discussion of the closed economy.

3.2 A small open economy

Let us now consider the case of a small open economy, in which prices for goods and services are determined in the world market and are thus exogenously given for the small economy. Trade in tasks is excluded for the moment. To fix ideas, we assume that the relative price of goods is higher in the open than the closed economy: $\pi > \pi_a$. In line with the Stopler-Samuelson theorem trade then increases the skill premium, $\omega > \omega_a$, because the production of goods is skill intensive (and because production is diversified as long as $0 < \hat{e} < 1$). The government in home maximizes an objective function of the form

$$\hat{V}(\hat{e}) = \pi^{-\gamma}\left\{\pi[1-F(\hat{e})] + F(\hat{e})\right\}F(\hat{e}), \tag{11}$$

where $\pi = \omega$ is exogenously given by the world market. The first-order condition to this maximization problem is given by

$$\hat{V}'(\hat{e}) = \pi^{-\gamma}F'(\hat{e})\left[\pi - 2(\pi-1)F(\hat{e})\right] = 0, \tag{12}$$

which has a unique interior solution $\hat{e}_t \in (0,1)$ that is implicitly given by $F(\hat{e}_t) = \pi/[2(\pi-1)] \equiv \rho(\pi)$. Thereby, subscript t refers to the trade regime. Accounting for $\rho(\pi_a) = 1-\gamma/2$, $\rho'(\pi) < 0$, and $\lim_{\pi\to\infty}\rho(\pi) = 1/2$, we can safely conclude that $\pi > \pi_a$ establishes $\hat{e}_t \in (0, \hat{e}_a)$ in the open economy.

The increase in teaching input augments the already positive welfare effect of trade, implying

$$v(\pi) = \frac{\pi^{2-\gamma}}{4(\pi-1)} > \frac{\pi_a^{2-\gamma}}{4(\pi_a-1)} = v(\pi_a). \tag{13}$$

We now contrast the small open economy with trade in goods and services with a small open economy in which tasks are also tradable. For a simple representation of our argument, we impose symmetry of tasks in their prevalence for goods production, $\alpha = 1/2$, and assume that one of the two tasks becomes offshorable and experiences a price drop to P_S, whereas the other task remains to be produced domestically.[9] Moreover, to capture the perceived risk of job loss that people often associate with the phenomenon of offshoring (cf. Geishecker et al., 2012), we impose the additional assumption that neither households nor the government know, which task will be offshorable ex post, when making the schooling decisions, but have an expectation that the probability for each task to be the one offshorable is the same for the two tasks.

Skilled workers specialized in the offshorable task will experience a wage cut. Given that the price of the task falls to P_S, the labor return of these workers will be the same in the production of the offshorable task and the production of services, rendering them indifferent between these two occupations (provided that they can switch sectors at no further cost).[10] This implies that the the domestic production level of the offshored task is undetermined. But given the price drop, it is clear that the country imports the offshorable task, which therefore becomes actually offshored. From Eq. (5), we further know that $P_G = w_L\sqrt{\omega}$ and $\omega = \pi^2$, so that the objective of the government is given by

$$\tilde{V}(\hat{e}) = \frac{\pi^{-\gamma}}{2}\left\{\pi^2[1-F(\hat{e})] + 1 + F(\hat{e})\right\}F(\hat{e}). \tag{14}$$

The first-order condition to the government's maximization problem corresponds to

$$\tilde{V}'(\hat{e}) = \frac{\pi^{-\gamma}F'(\hat{e})}{2}\left[\pi^2 + 1 - 2(\pi^2-1)F(\hat{e})\right] = 0 \tag{15}$$

and it has a unique interior solution $\hat{e}_o \in (0,1)$ that is implicitly given by $F(\hat{e}_o) = (\pi^2+1)/[2(\pi^2-1)] \equiv \tilde{\rho}(\pi)$. Due to $\pi > \pi_a > 2$, it follows that $\tilde{\rho}(\pi) < \rho(\pi)$ and thus $\hat{e}_o < \hat{e}_t$, where subscript o is used to distinguish the scenario with trade in tasks (*o*ffshoring) from the scenario with trade in goods and services only. The government chooses a lower schooling threshold, if trade in tasks is possible. This shows that

[9] In Section 5, we analyze how our results change, when giving up these two restrictive assumptions.

[10] Under the considered schooling system, workers who are threatened by offshoring cannot use their acquired skill in the performance of the other task.

the additional gains from trade in tasks are high and compensate for the ex post useless schooling of those workers specialized in the production of the offshored task. Utilitarian welfare in the open economy with task trade is given by

$$\tilde{V}(\hat{e}_o) = \frac{\pi^{2-\gamma}}{4(\pi-1)}\frac{\pi^2+1}{\pi^2}\frac{\pi^2+1}{2(\pi+1)} = v(\pi)\frac{\pi^2+1}{\pi^2}\frac{\pi^2+1}{2(\pi+1)} \equiv \tilde{v}(\pi), \tag{16}$$

and hence $\tilde{v}(\pi) >,=,< v(\pi)$ if $\zeta(\pi) \equiv (\pi^2+1)^2 - 2\pi^2(\pi+1) >,=,< 0$. From $\pi > \pi_a > 2$, it follows that $\zeta(\pi) > 0$ and thus $\tilde{v}(\pi) > v(\pi)$, implying that welfare in the open economy is higher with than without trade in tasks.[11] Whereas trade increases social welfare in our setting, its merits are not equally shared by workers. In fact, evaluating Eqs. (12) and (15) at $F(\hat{e}) = 1/2$, we find that more than 50 percent of the population stay unskilled and thus lose from openness. This raises the question of political support for trade, which will be tackled in the next section.

The following proposition summarizes the results from the analysis in this section.

Proposition 1 *Both trade in goods and services and trade in tasks have positive welfare effects, which are reinforced by an increase of public schooling expenditure in the open economy. Although there are gains from trade in the aggregate, a majority of households is wore off in the open than the closed economy.*

Proof Analysis in the text.

4 Trade reform and political support

In this section, we consider a two-stage policy game, in which the government chooses the schooling threshold in step one, whereas the electorate decides upon a movement from autarky to free trade after the schooling decisions of households have been made. Thereby, we consider a majority voting system, so that at least 50 percent of the electorate must be better off in the open economy for the trade reform to be implemented. We distinguish two scenarios. In Section 4.1, we consider the scope for policy intervention under a given schooling system. In Section 4.2, we account for an alternative schooling system, which provides a broader skill set that lowers productivity in the performance of either task, but at the same time allows graduates to move between the two tasks without a loss of their expertise.

[11] To see this, note that twice differentiating $\zeta(\pi)$ gives $\zeta'(\pi) = 4\pi^3 - 6\pi^2$, $\zeta''(\pi) = 12\pi(\pi-1) > 0$. Then, acknowledging $\zeta(2) = 1$, $\zeta'(2) = 8$ establishes the result in the text.

4.1 Policy intervention for a given schooling system

We first consider a scenario with trade in goods and services only. In this case, the government can convince the electorate to vote for free trade by choosing a sufficiently low schooling threshold to guarantee $F(\hat{e}) \leq 1/2$. Since $F(\hat{e}_t) > 1/2$, this implies excessive schooling from the perspective of a social planner who is not constrained by majority voting. Hence, the best the government can do is to minimize the social cost of excessive schooling by setting $F(\hat{e}) = 1/2$. This corresponds to a social welfare level of

$$\hat{V}(\hat{e}_m) = \frac{\pi^{-\gamma}(\pi+1)}{4} = v(\pi)\frac{\pi^2-1}{\pi^2} \equiv v_m(\pi), \tag{17}$$

where subscript m is used to indicate variables that are derived under the constraint that a majority of the electorate must support free trade and therefore $\hat{e}_m \equiv F^{-1}(1/2)$. It is easily confirmed that $v_m(\pi_a) < v(\pi_a)$, $v_m'(\pi) > 0$ and $\lim_{\pi\to\infty} v_m(\pi) = \infty$, implying that there exists a critical $\pi_m > \pi_a$ such that social welfare – under the constraint that 50 percent of the population must be skilled for a majority of voters to support free trade – is higher (lower) in the open than the closed economy if $\pi > (<)\pi_m$. This implies that with an endogenous adjustment in public schooling expenditure, trade reforms that involve a stronger relative price change are more likely to be successful. Higher relative price changes increase the gains from trade and therefore provide a larger scope for covering the additional costs of excessive schooling that must be borne to make a majority of households better off with free trade than under autarky.

Before turning to the scenario with trade in tasks, it is worth to have a closer look on whether the majority of the electorate will also support the increase in public schooling expenditure. For this purpose, we have to distinguish three groups of workers by their learning abilities. Workers with low abilities $e < 1/2$ will remain unskilled even after a fall in the schooling threshold and will therefore be against the adjustment in public schooling expenditure, because they have to cover part of the extra costs, but do not benefit from the merits of a higher skill premium in the open economy. In contrast, workers with abilities from interval $[1/2, \hat{e}_a)$ would be unskilled in the closed economy at a schooling threshold $\hat{e}_a$ but are skilled in the open economy if the schooling threshold implemented by the government falls to $\hat{e}_m = F^{-1}(1/2)$. For this group, real labor income in autarky with schooling threshold $\hat{e}_a$ and real labor income under free trade with schooling threshold $\hat{e}_m$ are given by[12]

$$\left(\frac{w_L}{P}\right)_a = \pi_a^{-\gamma} F(\hat{e}_a), \qquad \left(\frac{w_H}{P}\right)_m = \frac{1}{2}\pi^{1-\gamma}, \tag{18}$$

[12] Real labor incomes in Eq. (18) are net of the resources collected by the government to provide the public teaching input.

respectively. Substituting $F(\hat{e}_a) = \pi_a/[2(\pi_a - 1)]$, we find that $\pi > \pi_a > 2$ (and thus $\pi \geq \pi_m$) is sufficient for $(w_H/P)_m > (w_L/P)_a$. This implies that households switching from unskilled to skilled are better off in the open than the closed economy and will therefore support the increase in public schooling expenditure. Finally, households with learning abilities $e \geq \hat{e}_a$ will choose schooling in the closed and the open economy. The real labor income of skilled workers under autarky is given by

$$\left(\frac{w_H}{P}\right)_a = \pi_a^{1-\gamma} F(\hat{e}_a) = \frac{\pi_a^{2-\gamma}}{2(\pi_a - 1)}. \tag{19}$$

Evaluated at $\pi = \pi_m$ we find that $(w_H/P)_m < (w_H/P)_a$,[13] implying that $\pi \geq \pi_m$ is not sufficient for households with learning abilities $e \geq \hat{e}_a$ to support the trade plus schooling reform, because a fall in the schooling threshold necessary to get support from a majority of voters for the trade reform comes at the cost that a higher fraction of innate, unskilled labor endowment is used by the government for providing the now higher public teaching input. Eqs. (18) and (19) determine a threshold $\hat{\pi}_m > \pi_m$ such that trade reform plus increase in public schooling expenditure find support by a majority of the electorate if the government chooses to educate 50 percent of households.

We now look at a reform that allows not only for trade in goods and services but also for trade in tasks, imposing the same assumptions as in the previous section. In addition, we assume that the electorate knows about which task can be put offshore when voting on the trade reform. In this case, all unskilled and 50 percent of the skilled workers are worse off in the open than the closed economy and lowering the schooling threshold is of no help to create support for the reform by a majority of households, because one half of the newly educated workers will be worse off in the open economy and thus disapprove the trade reform.

The following proposition summarizes the results from the analysis in this section.

Proposition 2 *If there is trade in goods and services only and gains from trade are sufficiently high, the government will choose excessive schooling to secure support for free trade by a majority of the electorate. If trade also allows for offshoring one of the two tasks used for the production of goods, a majority of the electorate will vote against free trade irrespective of how many households are educated.*

Proof Analysis in the text.

[13] From Eqs. (10) and (17), we can infer that $\pi_a^{2-\gamma}/(\pi_a - 1) = \pi_m^{-\gamma}(\pi_m + 1)$. Then, noting $(w_H/P)_m = \pi_m^{1-\gamma}/2$ from Eq. (18) and noting $(w_H/P)_a = \pi_a^{2-\gamma}/[2(\pi_a - 1)] = \pi_m^{-\gamma}(\pi_m + 1)/2$ from Eq. (19) confirms that $(w_H/P)_m < (w_H/P)_a$.

4.2 Policy intervention with a change in the schooling system

We now assume that the government can opt for an alternative schooling system in order to achieve support for the trade reform at stage 2 by a majority of the electorate. This alternative schooling system provides a broader skill set that can be used for performing both tasks at a lower productivity $\delta < 1$. Then, welfare is given by $\tilde{V}_\delta(\hat{e}) \equiv \pi^{-\gamma} \left\{ \pi^2 \delta [1 - F(\hat{e})] + F(\hat{e}) \right\} F(\hat{e})$, where $\delta \pi^2 > 1$ must hold to make schooling attractive for workers.[14] Educating 50 percent of the population gives utilitarian welfare

$$\tilde{V}_\delta(\hat{e}_m) \equiv \frac{\pi^{-\gamma}}{4} \left(\pi^2 \delta + 1 \right) \equiv \tilde{v}_\delta(\pi), \tag{20}$$

which for sufficiently high π is higher than welfare in the closed economy under the original schooling system. Under the sufficient condition $\delta \geq 1 - \gamma - [(1-\gamma)/(2-\gamma)]^2 \equiv d(\gamma)$, with $d'(\gamma) < 0$, $d(0) = 3/4$, and $d(1) = 0$, $\tilde{v}_\delta(\pi) \geq v(\pi_a)$ is guaranteed for all $\pi \geq \pi_a$.

Again, the schooling plus trade reform is not supported by workers with low learning abilities $e < 1/2$, because these workers remain unskilled under either schooling system and are worse off in the open than the closed economy. Workers with medium learning abilities $e \in [1/2, \hat{e}_a)$ are better off with a welfare-increasing schooling and trade reform, because they benefit from the higher labor income as skilled workers in the open economy (provided that $\pi^2 \delta > 1$). Finally, a welfare increase of the combined schooling plus trade reform is not sufficient to generate gains for households with high learning abilities $e \geq \hat{e}_a$. These households would choose schooling also in the closed economy and therefore lose from a fall of the schooling threshold all other things equal, because a larger fraction of their innate unskilled labor endowment is used by the government to provide the additional teaching input. The households can further lose if the return on broader skills is lower than the expected return of specialized skills. Similar to the scenario without trade in tasks, the losses are dominated, however, by the merits of higher real wages in the open economy if the increase in the relative price of goods and services is sufficiently pronounced.

The following proposition summarizes the main insights from the analysis above.

Proposition 3 *With trade in tasks, changing the schooling system to one that provides broader, less specialized skills can be a successful instrument to achieve support for free trade by a majority of the electorate. Implementing the alternative schooling system is attractive if the productivity loss from lower specialization is not too large and the gains from trade are significant.*

[14] In the Appendix, we discuss the case where the voters have no say on the trade reform and show that in this case there exists a critical $\hat{\delta} \in (2\pi^{-2}, 1)$ such that a welfare-maximizing government prefers the alternative schooling system (the original schooling system) for all $\delta > (<) \hat{\delta}$. Since the alternative schooling system lowers productivity in order to provide insurance against the risk of useless schooling, its implementation can only be attractive with trade in tasks.

Proof Analysis in the text.

5 Extensions

In the interest of readability, we have imposed two restrictive assumptions regarding the relative importance of the two tasks for the production of goods and the price drop for the offshored task. In this section, we discuss the relevance of these assumptions for our results and analyze whether lifting them gives a more promising picture about the successful implementation of trade reforms. In Section 5.1, we consider the case of asymmetric cost shares for the two tasks and, in Section 5.2, we allow the price for the offshored task to drop to a level different from the price of services.[15]

5.1 Trade in tasks with asymmetric cost shares

In contrast to the benchmark model, we now consider the case of trade in tasks for arbitrary levels of $\alpha \in (0,1)$. At the same time, we maintain the assumption that only one of the two tasks becomes offshorable and can be imported at a price equal to P_S. Furthermore, whereas households expect offshoring of the two tasks with equal probability ex ante, we assume without loss of generality that task 2 is offshored ex post. This changes the price of goods to $P_G = w_L \omega^\alpha$ and alters the link between the skill premium and the relative price of goods to services to $\omega = \pi^{\frac{1}{\alpha}}$. The objective of the government is then given by $\tilde{V}_\alpha(\hat{e}) \equiv \pi^{-\gamma}\big\{\alpha(\pi^{\frac{1}{\alpha}} - 1)[1 - F(\hat{e})] + 1\big\}F(\hat{e})$ and the welfare-maximizing schooling threshold, $\hat{e}_o$ is implicitly determined by $F(\hat{e}_o) = \frac{1}{2} + [2\alpha(\pi^{\frac{1}{\alpha}} - 1)]^{-1}$. For any $\pi > \pi_a > 2$, we have $F(\hat{e}_o) < F(\hat{e}_t)$, similar to the the benchmark model.[16] The welfare level achieved in the open economy is then given by

$$\tilde{V}_\alpha(\hat{e}_o) = v(\pi)\frac{(\pi - 1)(1 + \alpha(\pi^{\frac{1}{\alpha}} - 1))^2}{\pi^2\alpha(\pi^{\frac{1}{\alpha}} - 1)} \equiv \tilde{v}_\alpha(\pi), \tag{16'}$$

where $\tilde{v}_\alpha(\pi) > v(\pi)$ shows that the important insight from our benchmark model that offshoring further increases the gains from trade extends to arbitrary levels of α between zero and one.

Let us now turn to the policy game outlined in Section 4, in which the government sets the schooling threshold in a first stage and the electorate decides by majority voting about the trade reform in the second stage. Irrespective of the schooling threshold, unskilled workers lose from trade due to a standard Stolper-

[15] In the Appendix, we discuss a further extension, in which we make unskilled labor an additional input of task production. With this modification, it is possible that the country gives up production of services and fully specializes on the production of goods in the open economy. However, as long as a diversification equilibrium is reached, the insights from the benchmark model do not change.

[16] We summarize the main results here and present formal proofs in the Appendix.

Samuelson effect and will therefore always vote against the trade reform. Things are similar for those skilled workers that are specialized in the task, which is at risk to be offshored to the foreign country. The labor return for this group drops to the level of unskilled workers with whom they share the losses from unfavorable price effects. In contrast, skilled workers specialized in the task that remains to be produced at home benefit from trade because the price of the task they are specialized in increases in the open economy. However, these workers lose from excessive schooling, the government must implement in order to achieve support for the trade reform by a majority of the electorate.

In the benchmark case of $\alpha = 1/2$, lowering the schooling threshold can never be a successful policy for implementing the trade reform through majority voting. This is, because irrespective of the schooling threshold less than 50 percent of households will be employed in the task whose price increases and therefore benefit from trade. This outcome changes, if $\alpha \neq 1/2$. More specifically, a majority of households is skilled and employed in the production of non-offshored task 1, and therefore benefits from trade if $\alpha[1 - F(\hat{e})] \geq 1/2$. This requires $\alpha > 1/2$, so that a trade reform can only be successful if the task using the lower fraction of skilled workers is offshored in the open economy.

The government has two options. It can either choose the preferred schooling level under autarky, educate less than 50 percent of the electorate, and accept that the proposal for a trade reform will be rejected by a majority of voters. Or, it can opt for a schooling threshold $\hat{e}_p$ under the veil of uncertainty, which is implicitly given by $F(\hat{e}_p) = 1 - (2\alpha)^{-1}$,[17] and hope that task 2 turns out to be offshored ex post. Assuming that each task will be offshored with the same ex ante probability of 1/2, expected welfare is given by

$$\tilde{V}_m(\hat{e}_p) \equiv \frac{1}{2}\left\{\pi^{-\gamma}\left[\alpha(\pi^{\frac{1}{\alpha}} - 1)[1 - F(\hat{e}_p)] + 1\right]F(\hat{e}_p)\right\} + \frac{1}{2}\left\{\frac{F(\hat{e}_p)^{2-\gamma}[1 - F(\hat{e}_p)]^{\gamma}}{\gamma^{\gamma}(1-\gamma)^{1-\gamma}}\right\}$$

in this case, where the first element is welfare under trade in tasks multiplied by the probability of $1/2$ that task 2 is offshorable ex post, and hence the trade reform accepted by the electorate; and the second element is the welfare achieved in the closed economy multiplied by the probability of $1/2$ that task 1 is offshorable ex post, and hence the trade reform rejected by the electorate. Substituting $F(\hat{e}_p) = 1 - (2\alpha)^{-1}$, gives

$$\tilde{V}_m(\hat{e}_p) = \frac{2\alpha - 1}{4\alpha}\left\{\frac{\pi^{-\gamma}}{2}(\pi^{\frac{1}{\alpha}} + 1) + \frac{(2\alpha - 1)^{1-\gamma}}{2\alpha\gamma^{\gamma}(1-\gamma)^{1-\gamma}}\right\} \equiv \tilde{v}_m(\pi, \alpha). \tag{17'}$$

[17] Setting $\hat{e} > \hat{e}_p$ would not give support for the trade reform by a majority of voters even if task 2 is offshorable ex post. Setting $\hat{e} < \hat{e}_p$ cannot be optimal either, because it would further increase the social cost of excessive schooling, without changing the outcome of the referendum about the trade reform.

Contrasting this outcome with $v(\pi_a) = (2-\gamma)^{2-\gamma}/[4(1-\gamma)^{1-\gamma}]$ from Eq. (10) reveals that a (risk-neutral) utilitarian government would opt for excessive schooling and a 50 percent chance for a trade reform if the terms of trade in the open economy are sufficiently good.[18] However, if both tasks are similarly important for the production of goods and thus α close to $1/2$, the government cannot get support for free trade by a majority of the electorate and at the same time achieve welfare gains. In this case, the government can only change the schooling system to one that provides broader, less specialized skills, in order to secure support for the trade reform by a majority of voters.

5.2 Trade in tasks with arbitrary cost changes

In this section, we maintain the assumption of $\alpha = 1/2$ from the main text, but now allow for arbitrary changes in the price of the offshored task. Assuming that skilled workers initially producing the offshored task can move at no extra cost to the service sector and provide unskilled labor input there, it is immediate that the analysis from the benchmark model extends one-to-one to a scenario, in which the price of the offshored task falls to a level lower than P_S. Things are more complicated, however, if the price of the offshored task lies between P_S and P_G. In this case, skilled workers producing the offshored task have no incentive to move to the service sector and their skill premium, $\hat{\omega}$, is equal to the relative price of the offshored task to services, $\hat{\pi}$, whereas the skill premium of workers producing the non-offshored task equals $\omega = \pi^2/\hat{\pi}$. For $\hat{\pi} \in (1, \pi)$, we therefore have $\omega > \hat{\omega}$, so that the skill premium is lower for workers producing the offshored task.

With these assumptions at hand, we can express utilitarian welfare for the scenario with trade in tasks as follows $\tilde{V}_\pi(\hat{e}) \equiv \frac{\pi^{-\gamma}}{2}\left\{\frac{\pi^2}{\hat{\pi}}[1-F(\hat{e})] + \hat{\pi}[1-F(\hat{e})] + 2F(\hat{e})\right\}F(\hat{e})$. The welfare-maximizing schooling threshold, $\hat{e}_o$, is then implicitly given by $F(\hat{e}_o) = (\pi^2+\hat{\pi}^2)/[2(\pi^2+\hat{\pi}^2-2\hat{\pi})]$. Intuitively, we have $F(\hat{e}_o) < F(\hat{e}_t)$. However, the schooling threshold is higher than in the benchmark model with $\hat{\pi} = 1$, because trade in tasks increases the social benefit of schooling, and this effect is reduced if the gains from trade are lower due to a higher import cost of the offshored task.[19]

Substituting $F(\hat{e}_o) = (\pi^2+\hat{\pi}^2)/[2(\pi^2+\hat{\pi}^2-2\hat{\pi})]$, welfare in the open economy is given by

$$\tilde{V}_\pi(\hat{e}_\pi) = v(\pi)\frac{\left(\pi^2+\hat{\pi}^2\right)^2(\pi-1)}{2\pi^2\hat{\pi}[\pi^2+\hat{\pi}^2-2\hat{\pi}]} \equiv \tilde{v}_\pi(\pi), \tag{16''}$$

where $\tilde{v}_\pi(\pi) > v(\pi)$, because the gains from trade are reinforced through offshoring if $\hat{\pi} < \pi$.[20]

[18] Note that $\tilde{v}_m(\pi,\alpha)$ increases in π and that $\lim_{\pi\to\infty}\tilde{v}_m(\pi,\alpha) = \infty$.

[19] Note that $F(\hat{e}_o)$ increases in $\hat{\pi}$. It reaches a minimum of $F(\hat{e}_o) = (\pi^2+1)/[2(\pi^2-1)]$ if $\hat{\pi} = 1$ and a maximum of $F(\hat{e}_o) = F(\hat{e}_t)$ if $\hat{\pi} = \pi$.

[20] We can define an auxiliary function $\hat{\zeta}(\hat{\pi}) \equiv \left(\pi^2+\hat{\pi}^2\right)^2(\pi-1) - 2\pi^2\hat{\pi}[\pi^2+\hat{\pi}^2-2\hat{\pi}]$, such that $\tilde{v}_\pi(\pi) > v(\pi)$ if

We now turn to the combined schooling plus trade reform for an arbitrary price drop. From the benchmark model, we can note that for the trade reform at stage 2 to have support from a majority of the electorate it is required that skilled workers who are specialized in the performance of the offshored task benefit from this reform. This is only possible if $\hat{\pi} > \pi^{\gamma}\pi_a^{1-\gamma} \equiv \xi(\pi)$. At any given schooling threshold $\hat{e}$, this condition is fulfilled for sufficiently high levels of $\hat{\pi}$, and it is guaranteed for any $\pi > \pi_a$ if $\hat{\pi} = \pi$, because in this case all skilled workers benefit from a standard Stolper-Samuelson effect. Provided that $\hat{\pi} > \xi(\pi)$ is fulfilled, the government must still educate 50 percent of the electorate, so that welfare under the combined schooling plus trade reform is given by

$$\tilde{V}_{\pi}(\hat{e}_m) = v(\pi)\frac{(\pi^2 + \hat{\pi}^2 + 2\hat{\pi})(\pi - 1)}{2\hat{\pi}\pi^2} \equiv \tilde{v}_m(\pi, \hat{\pi}). \tag{17''}$$

In the Appendix, we show that $\tilde{v}_m(\pi, \hat{\pi})$ increases in π and decreases in $\hat{\pi}$, so that $\tilde{v}_m(\pi, \hat{\pi}) = v(\pi_a)$ establishes a positive relationship between $\hat{\pi}$ and π: $\hat{\pi} = \hat{\xi}(\pi)$, with $\lim_{\pi \to \hat{\pi}^+} \hat{\xi}'(\pi) = \infty$. Furthermore, in the Appendix we also show that $\hat{\xi}(\pi_m) = \pi_m$ and that $\hat{\xi}(\pi) = \xi(\pi)$ has a unique intersection point on interval (π_a, π_m), which we denote π'. With these insights, we can illustrate the scope for policy intervention in Figure 1. There, the region for which the combined policy reform can be implemented ($\hat{\pi} > \xi(\pi)$) and is welfare-improving ($\hat{\pi} < \hat{\xi}(\pi)$) is given by the dashed area. This indicates that adjustments in public schooling expenditure can be a successful policy intervention to get support by a majority of the electorate for welfare-improving trade reforms if the cost reduction of the offshored task is not too strong, while at the same time the change in the relative price of goods to services is sufficiently pronounced.

From Figure 1, we see that the relative price change necessary to make the schooling plus trade reform welfare-improving is lower with trade in tasks than with trade in goods and services only. This is, because the price reduction for the offshored task provides a further welfare stimulus, thereby increasing the scope of the government to secure gains from trade through excessive schooling. This scope is limited, however, by the requirement that at least 50 percent of the households must be better off in the open than the closed economy in order for the trade reform to be accepted under majority voting. This constraint rules out a successful schooling plus trade reform if the price drop for the offshored task is too strong, leaving the implementation of an alternative schooling system that provides broader, less specialized skills the only option for the government in this case.

$\hat{\zeta}(\hat{\pi}) > 0$. It is easily verified that $\hat{\zeta}(1) = \zeta(\pi) > 0$ (see Section 3.2) and that $\hat{\zeta}(\pi) = 0$. Then,

$$\hat{\zeta}'(\hat{\pi})\big|_{\hat{\zeta}(\hat{\pi})=0} = 2\pi^2(\pi^2 + \hat{\pi}^2 - 2\hat{\pi})\left(\frac{2\hat{\pi}^2}{\pi^2 + \hat{\pi}^2} - 1\right) - 4\pi^2\hat{\pi}(\hat{\pi} - 1) < 0$$

establishes $\hat{\zeta}(\hat{\pi}) > 0$ for all $\hat{\pi} \in (1, \pi)$.

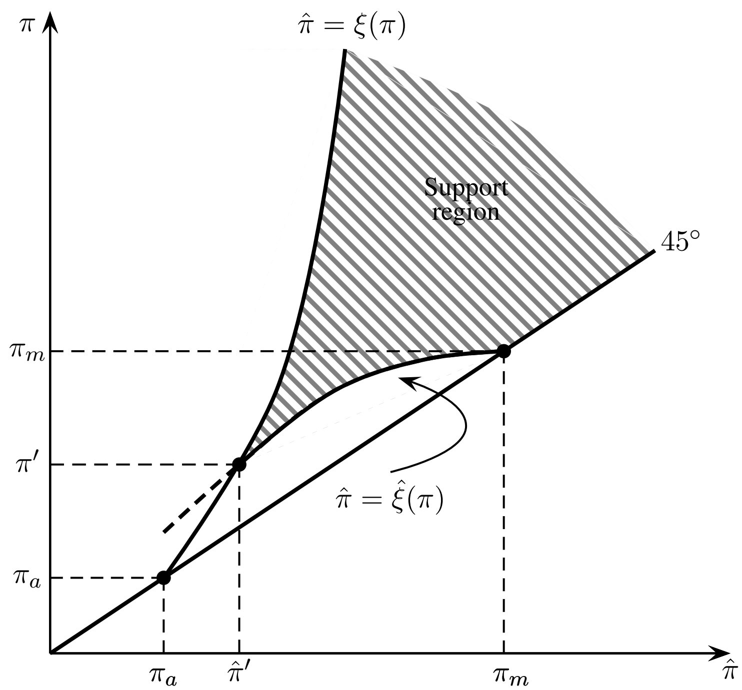

Figure 1: *Parameter domain with support for combined schooling and trade reform*

6 Conclusion

We have set up a model of a small open economy with two sectors and two factors of production. Adding task performance as an intermediate production step gives a framework, in which we can distinguish trade in goods and services from trade in tasks. Associating the two production factors with skilled and unskilled labor and assuming that their supplies are endogenous and determined by public education policy, we give the government an instrument to influence the distribution of gains from trade in our setting. We begin our analysis with reproducing the important insight from the Stolper-Samuelson theorem that skilled workers gain whereas unskilled workers lose if trade increases the relative price of the skill-intensive good. Gains from trade are further augmented and spread among a broader range of households if the government optimally adjusts public schooling expenditures and educates more workers. If schooling provides task-specific skills, our conclusions regarding gains from trade have to be modified, however, when trade in tasks makes some of the skills acquired through education obsolete in the open economy. In this case, part of the skilled workers lose along with unskilled workers and an expansion of public schooling expenditure is less effective in broadening the group of households benefitting from trade. This is, because it is unknown at the stage of the schooling decision, which tasks are put offshore, implying that some of the skills acquired are no longer needed ex post.

Adding a political economy framework, in which a trade reform is only implemented if a majority of households benefits from it, our analysis shows that expanding public schooling expenditure and educating more than 50 percent of the electorate is indeed a useful instrument to secure support for trade reform by a majority of voters if the exchange of goods and services promises sufficiently high gains to compensate for the additional resources needed for (excessive) schooling. This reasoning is no longer valid, however, if the reform also allows for trade in tasks. Because part of the skilled workforce loses from trade, educating a majority of households is not sufficient for the proposal of trade reform to be successful in a referendum. This challenges the widespread view that education is a remedy for resistance to globalization and it provides a rationale for why trade openness seems to lose support among workers with relatively high skill levels.

Our analysis highlights an important trade-off between gains from specialization of skilled workers in the performance of tasks, on the one hand, and gains from specialization in production due to international trade, on the other hand. Whereas gains from specialization have be identified as a key engine of economic growth since the beginning of economic research, it is also well understood that uncertainty provides limits to reaping its benefits if higher degrees of specialization are associated with higher vulnerability to potential losses. Since in the era of offshoring globalization can lead to losses for highly specialized skilled workers, it is likely to be disapproved by them. The resistance of skilled workers can be reduced, however, by lowering their vulnerability to trade loss through a reduction in the degree of specialization of the skills acquired by education. To overcome the resistance to globalization, we therefore suggest a larger reform of the schooling system in order provide less-specific skills, which may have lower productivity for the execution of certain tasks but are also less vulnerable to globalization shocks as they can be used for a wider range of activities. With a thoughtful schooling reform, welfare-improving trade liberalization would then be supported by a majority of voters in industrialized economies even if trade includes not only the exchange of goods and services but also the exchange of tasks.

Limiting the set of policy instruments to schooling expenditure, our analysis abstracts from other forms of intervention the government may choose to increase support for trade reform. One natural candidate in our setting are non-tariff barriers, such as labor or product standards. Whereas such barriers reduce the gains from trade in a small open economy, they may help to implement trade reforms. For instance, increasing the price of imported tasks can be a meaningful policy to secure support for trade liberalization by a majority of voters. However, the government must choose its instruments with care in order to avoid unintended side effects. In particular, the interactions of different policy instruments in the context of trade in tasks can be quite complicated. Considering more than just one policy instrument is therefore a worthwhile task for future research.

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A Appendix

A.1 An alternative schooling system in the open economy

In the subsequent, we discuss the open economy equilibrium without majority voting for the alternative schooling system outlined in Section 4.2. The alternative schooling system provides skills which then can be used to produce $\delta < 1$ units of either task. Then, utilitarian welfare is given by $\tilde{V}_\delta(\hat{e}) = \pi^{-\gamma}\left\{\pi^2\delta[1-F(\hat{e})]+F(\hat{e})\right\}F(\hat{e})$, and the welfare-maximizing schooling threshold $\hat{e}_\delta$ is implicitly given by $F(\hat{e}_\delta) = \pi^2\delta/[2(\pi^2\delta-1)]$. This outcome has been derived under the assumption of an internal solution, which requires $F(\hat{e}_\delta) \in (0,1)$ and thus $\pi^2\delta > 2$. Evaluated at the optimum, welfare is given by

$$\tilde{V}_\delta(\hat{e}_\delta) = v(\pi)\frac{\delta^2\pi^2(\pi-1)}{\pi^2\delta-1} \equiv \tilde{v}_\delta(\pi). \tag{A.1}$$

Contrasting Eqs. (16) and (A.1), we find that $\tilde{v}_\delta(\pi) >,=,< \tilde{v}(\pi)$ if $F(\delta) \equiv 2\left(\delta\pi^2\right)^2/(\pi^2\delta-1)-(\pi^2+1)^2/(\pi^2-1) >,=,< 0$. We can compute $F(2\pi^{-2}) = 8-(\pi^2+1)^2/(\pi^2-1) < 8-25/3 < 0$ and $F(1) = [2\pi^4-(\pi^2+1)^2]/(\pi^2-1) > 0$. Then, noting that $F'(\delta) > 0$, there exists a unique $\hat{\delta} \in (2\pi^{-2}, 1)$, such that $F(\delta) >,=,< 0$ if $\delta >,=,< \hat{\delta}$. This completes the formal discussion and proves the statements in Footnote 14.

A.2 Formal proof for important results in Section 5.1

We first show that $\hat{e}_o < \hat{e}_t$ extends to arbitrary levels of α. For this purpose, we introduce the auxiliary expression $x(\alpha) \equiv \alpha(\pi^{\frac{1}{\alpha}}-1)$. Then, acknowledging $\hat{e}_t = \pi/[2(\pi-1)]$ and $\hat{e}_o = [1+x(\alpha)]/x(\alpha)$, we find that $\hat{e}_o < \hat{e}_t$ if $\pi-1-x(\alpha) < 0$. Twice differentiating $x(\alpha)$ gives $x'(\alpha) = \pi^{\frac{1}{\alpha}}[1-\frac{1}{\alpha}\ln\pi]-1$ and $x''(\alpha) = \alpha^{-3}(\ln\pi)^2\pi^{\frac{1}{\alpha}} > 0$. Noting that $x'(1) = \pi[1-\ln\pi]-1$ is negative for any $\pi > 2$, it follows that $\pi-1-x(1) = 0$ is sufficient for $\hat{e}_o < \hat{e}_t$ to hold for all $\alpha < 1$.

In a next step, we show that $\tilde{v}_\alpha(\pi) > v(\pi)$. Using the definition of $x(\alpha)$ in Eq. (16′), it follows that $\tilde{v}_\alpha(\pi) > v(\pi)$ if $f(\alpha) \equiv [1+x(\alpha)]^2/x(\alpha) > \pi^2/(\pi-1)$. Differentiating $f(\alpha)$ establishes $f'(\alpha) = x'(\alpha)[x(\alpha)^2-1]/x(\alpha)^2$. Accounting for $x'(\alpha) < 0$ from above, we have $x(\alpha) > x(1) = \pi-1$ and therefore $f'(\alpha) < 0$. This implies $f(\alpha) > f(1) = \pi^2/(\pi-1)$ and establishes $\tilde{v}_\alpha(\pi) > v(\pi)$ for all $\alpha < 1$.

A.3 Derivation of $\hat{\xi}(\pi)$ and discussion of its relationship to $\xi(\pi)$

Substituting $v(\pi) = \pi^{2-\gamma}/[4(\pi-1)]$ into Eq. (17″), we can rewrite $\tilde{v}_m(\pi;\hat{\pi}) = v(\pi_a)$ as an implicit function of the form

$$\Gamma(\pi,\hat{\pi}) \equiv \frac{\pi^2+\hat{\pi}^2+2\hat{\pi}}{\pi^\gamma\hat{\pi}} - 8v(\pi_a) = 0. \tag{A.2}$$

Differentiating $\Gamma(\cdot)$ with respect to π and $\hat{\pi}$ gives

$$\frac{\partial\Gamma}{\partial\pi} = \frac{(2-\gamma)\pi^2-\gamma\left(\hat{\pi}^2+2\hat{\pi}\right)}{\pi^{1+\gamma}\hat{\pi}}, \qquad \frac{\partial\Gamma}{\partial\hat{\pi}} = \frac{\hat{\pi}^2-\pi^2}{\pi^\gamma\hat{\pi}^2}.$$

Whereas $\partial\Gamma/\partial\hat{\pi} < 0$ follows directly from $\hat{\pi} \in (1,\pi)$, the sign of $\partial\Gamma/\partial\pi$ is less obvious. However, rearranging the numerator, it follows that $\partial\Gamma/\partial\pi >,=,< 0$ is equivalent to $2\pi^2/[\pi^2+\hat{\pi}^2+2\hat{\pi}] >,=,< \gamma$.

Noting further that $2\pi^2/[\pi^2+\hat{\pi}^2+2\hat{\pi}] > \pi/(\pi+1) > \pi_a/(\pi_a+1) = (2-\gamma)/(3-2\gamma)$, we can conclude that $\psi(\gamma) \equiv (2-\gamma)/(3-2\gamma) - \gamma > 0$ is sufficient for $\partial\Gamma/\partial\pi > 0$. Accounting for $\psi'(\gamma) < 0$ and $\psi(1) = 0$, then reveals that $\partial\Gamma/\partial\pi > 0$ must hold for all possible γ. Applying the implicit function theorem to Eq. (A.2) then establishes

$$\left.\frac{d\hat{\pi}}{d\pi}\right|_{\Gamma=0} = \frac{\hat{\pi}[(2-\gamma)\pi^2 - \gamma(\hat{\pi}^2+2\hat{\pi})]}{\pi(\pi^2-\hat{\pi}^2)}, \tag{A.3}$$

which is positive for any $\pi > \hat{\pi}$. We can therefore conclude that $\Gamma(\pi,\hat{\pi}) = 0$ determines $\hat{\pi}$ as an implicit function of π: $\hat{\pi} = \hat{\xi}(\pi)$, with $\hat{\xi}'(\pi) > 0$ and $\lim_{\pi\to\hat{\pi}^+} \hat{\xi}'(\pi) = \infty$.

To determine location and slope of $\xi(\pi)$ and $\hat{\xi}(\pi)$ in Figure 1, we can first note from the definition of $\xi(\pi) = \pi^\gamma \pi_a^{1-\gamma}$ that $\xi(\pi_a) = \pi_a$, $\xi'(\pi) = \gamma\xi(\pi)/\pi > 0$, and therefore $\xi(\pi) > \pi_a$ for all $\pi > \pi_a$. Furthermore, from the definition of $\Gamma(\cdot) = 0$, we know that $\hat{\xi}(\pi_m) = \pi_m$ and that $\hat{\xi}(\pi) < \pi$ for all $\pi < \pi_m$ (due to $\lim_{\pi\to\hat{\pi}^+} \hat{\xi}'(\pi) = \infty$). Hence, there must exist a $\pi' \in (\pi_a, \pi_m)$, such that $\xi(\pi') = \hat{\xi}(\pi') \equiv \hat{\pi}'$. To show uniqueness of this intersection point, we can finally note that $\hat{\xi}'(\pi') >,=,< \xi'(\pi')$ if $g(\pi') \equiv 2\left[(1-\gamma)(\pi')^2 - \gamma\hat{\pi}'\right] >,=,< 0$. Noting that $g(\pi') > 2\pi'[(1-\gamma)\pi - \gamma]$ and that $(1-\gamma)\pi - \gamma > (1-\gamma)\pi_a - \gamma = 2(1-\gamma) > 0$, we can safely conclude that $\hat{\xi}'(\pi') > \xi'(\pi')$, so that the intersection point of $\xi(\pi)$ and $\hat{\xi}(\pi)$ on interval (π_a, π_m) must be unique. This completes the proof.

A.4 Task production with skilled and unskilled labor

In contrast to the benchmark model, we now assume that performance of task $i = 1, 2$ requires skilled and unskilled labor, which are combined in a Cobb-Douglas technology of the form

$$X_i = \left(\frac{H_i}{\beta}\right)^\beta \left(\frac{L_i}{1-\beta}\right)^{1-\beta}.$$

Thereby, H_i, L_i are skilled and unskilled labor and $\beta \in (0,1)$ gives the cost share of skilled labor in the production of task i. Total unskilled labor input for the production of goods is then given by $L_1 + L_2 \equiv L_G$. We assume that unskilled labor is mobile between the two sectors and between the two tasks. Then, labor market clearing leaves $L - L_G$ workers for the production of services and the profit maximizing choice of inputs establishes

$$\begin{aligned} \alpha\beta P_G Y_G &= w_H^1 H_1, \qquad & (1-\alpha)\beta P_G Y_G &= w_H^2 H_2, \\ (1-\beta) P_G Y_G &= w_L L_G, \qquad & P_S Y_S &= w_L (L - L_G), \end{aligned} \tag{A.4}$$

where $w_H^1 \neq w_H^2$ is possible due to ex post immobility of skilled workers between the two tasks. The price of task i is now given by $P_i = (w_H^i)^\beta (w_L)^{1-\beta}$ instead of $P_i = w_H^i$, and prices of goods can be expressed as functions of skilled and unskilled wages according to: $P_G = (w_H^1)^{\alpha\beta}(w_H^2)^{(1-\alpha)\beta} w_L^{1-\beta}$.

In the closed economy, the households' education decision equalizes the return on skilled labor input in the production of the two tasks, establishing $w_H^1 = w_H^2 \equiv w_H$ and $P_G = w_H^\beta w_L^{1-\beta}$. As a consequence, the skill premium is linked to the relative price of goods and services by $\omega = \pi^{\frac{1}{\beta}}$ and relative demand and supply of goods and services are given by

$$\frac{Z_G}{Z_S} = \frac{\gamma}{1-\gamma}\frac{1}{\omega^\beta}, \qquad \frac{Y_G}{Y_S} = \omega^{1-\beta}\frac{H}{\beta L - (1-\beta)\omega H}, \tag{A.5}$$

instead of Eq. (6). Accounting for goods market clearing, $Z_j = Y_j$, $j = G, S$ and setting $H = [1 -$

$F(\hat{e})][1-k(\hat{e})]$, $L = F(\hat{e})[1-k(\hat{e})]$, the implicit relationship between threshold ability $\hat{e}$ and skill premium ω changes to

$$\omega = \frac{\beta\gamma}{1-\beta\gamma}\frac{F(\hat{e})}{1-F(\hat{e})}, \tag{A.6}$$

where $\lim_{\hat{e}\to 0}\omega = 0$, $\lim_{\hat{e}\to 1}\omega = \infty$, and $d\omega/d\hat{e} > 0$, is preserved from the main text. Maximizing indirect utility of the average household,

$$V_\beta(\hat{e}) \equiv \frac{F(\hat{e})^{2-\beta\gamma}[1-F(\hat{e})]^{\beta\gamma}}{(\beta\gamma)^{\beta\gamma}(1-\beta\gamma)^{1-\beta\gamma}},$$

a utilitarian government will choose an ability threshold separating unskilled and skilled workers that is implicitly given by $F(\hat{e}_a) = 1-\beta\gamma/2$. This solution is unique and from Eq. (A.6) we can infer $\omega_a = \pi_a^{\frac{1}{\beta}} = (2-\beta\gamma)/(1-\beta\gamma)$ and thus $F(\hat{e}_a) = \pi_a^{\frac{1}{\beta}}/[2(\pi_a^{\frac{1}{\beta}}-1)]$. Evaluated at the optimum, social welfare corresponds to

$$V_\beta(\hat{e}_a) = \frac{\pi_a^{\frac{2}{\beta}-\gamma}}{4(\pi_a^{\frac{1}{\beta}}-1)} \equiv v_\beta(\pi_a). \tag{A.7}$$

For trade in goods and services only, an increase in the relative price of goods from π_a to $\pi > \pi_a$ can now lead to full specialization on the production of goods. We discuss the condition ruling out full specialization below and simply assume for the moment that production remains diversified in the open economy. In this case, the link between the skill premium and the relative price of goods to services remains to be given by $\omega = \pi^{\frac{1}{\beta}}$, so that the skill premium increases with the relative price π, in line with the Stolper-Samuelson theorem: $\omega > \omega_a$. Welfare in the open economy can be expressed as $\hat{V}_\beta(\hat{e}) = \pi^{-\gamma}\left\{\pi^{\frac{1}{\beta}}[1-F(\hat{e})]+F(\hat{e})\right\}F(\hat{e})$, where π is given for the small country by the world market. Maximizing welfare, the utilitarian government chooses a schooling threshold from the unit interval that is implicitly given by $F(\hat{e}_t) = \pi^{\frac{1}{\beta}}/[2(\pi^{\frac{1}{\beta}}-1)]$, implying that $\pi > \pi_a$ establishes $\hat{e}_t \in (0,\hat{e}_a)$ in the open economy. The increase in teaching input augments the already positive welfare effect of trade, implying

$$v_\beta(\pi) = \frac{\pi^{\frac{2}{\beta}-\gamma}}{4(\pi^{\frac{1}{\beta}}-1)} > \frac{\pi_a^{\frac{2}{\beta}-\gamma}}{4(\pi_a^{\frac{1}{\beta}}-1)} = v_\beta(\pi_a). \tag{A.8}$$

With these insights at hand, we now derive an upper bound for π such that $L_G < L$ makes production diversified. Setting $w_H^1 = w_H^2$ in the first-order conditions of (A.4), we can derive

$$\frac{\beta}{1-\beta}\frac{L_G}{L} = \omega\frac{H}{L}. \tag{A.9}$$

Hence, $L_G < L$ is equivalent to $\beta L - (1-\beta)\omega H > 0$. Substituting $\omega = \pi^{\frac{1}{\beta}}$ and evaluating $L/H = F(\hat{e})/[1-F(\hat{e})]$ at $F(\hat{e}) = \pi^{\frac{1}{\beta}}/[2(\pi^{\frac{1}{\beta}}-1)]$, then establishes $\pi < [2+\beta/(1-\beta)]^\beta$ as the parameter constraint for supporting diversified production in the open economy. Due to our assumption of $\pi > \pi_a > 2$, diversification therefore requires a sufficiently high level of β.

For the scenario with task trade, we assume that one of the two tasks becomes offshorable and can be imported at a price equal to P_S. Furthermore, we set $\alpha = 1/2$, as in the benchmark model, and consider a diversification equilibrium. This changes the price of goods to $P_G = w_L \omega^{\frac{\beta}{2}}$ and alters the link between the skill premium and the relative price of goods to services to $\omega = \pi^{\frac{2}{\beta}}$. The objective of the government is then given by $\tilde{V}_\beta(\hat{e}) \equiv \frac{\pi^{-\gamma}}{2}\big[\pi^{\frac{2}{\beta}}(1 - F(\hat{e})) + 1 + F(\hat{e})\big]F(\hat{e})$ and the welfare-maximizing schooling threshold, $\hat{e}_o$ is implicitly determined by $F(\hat{e}_o) = \big(\pi^{\frac{2}{\beta}} + 1\big)/\big[2\big(\pi^{\frac{2}{\beta}} - 1\big)\big]$. Since $\pi > \pi_a > 2$, it follows that $\hat{e}_o < \hat{e}_t$. The welfare level achieved in the open economy with trade in tasks is then given by

$$\tilde{V}_\beta(\hat{e}_o) = v_\beta(\pi)\frac{\big(\pi^{\frac{1}{\beta}} - 1\big)\big(\pi^{\frac{2}{\beta}} + 1\big)^2}{2\pi^{\frac{2}{\beta}}\big(\pi^{\frac{2}{\beta}} - 1\big)} \equiv \tilde{v}_\beta(\pi), \tag{A.10}$$

where $\tilde{v}_\beta(\pi) > v_\beta(\pi)$ can be shown, following the same steps as in the main text. Similar to the scenario with trade in goods and services only, diversification of production in the open economy imposes a ceiling for the relative price of goods to services. Assuming that all skilled workers remain to be employed in the production of goods, we can follow the steps above to show that diversification requires $\beta L > (1-\beta)\omega H$. Substituting $\omega = \pi^{\frac{2}{\beta}}$ and evaluating $L/H = F(\hat{e})/[1 - F(\hat{e})]$ at $F(\hat{e}) = \big(\pi^{\frac{2}{\beta}} + 1\big)/\big[2\big(\pi^{\frac{2}{\beta}} - 1\big)\big]$, we obtain $\pi < \big\{\big(3 - 2\beta + \sqrt{9 - 8\beta}\big)/[2(1 - \beta)]\big\}^{\frac{\beta}{2}}$ for the parameter constraint supporting diversified production in an open economy with task trade. Again, due to $\pi > \pi_a > 2$ diversification requires a sufficiently high level of β.

Let us now turn to the policy game outlined in Section 4, in which the government sets the schooling threshold in a first stage and the electorate decides by majority voting about the implementation of a trade reform in a second stage. Without trade in tasks the government can set a sufficiently low schooling threshold to ensure support for the trade reform. Since unskilled workers lose from trade and will therefore oppose the reform, support for it by a majority of the electorate requires $F(\hat{e}) \leq 1/2$. Maximizing Eq. (A.8) gives the corner solution $F(\hat{e}) = 1/2$. This implies a social welfare level of

$$\hat{V}_\beta(\hat{e}_m) = v(\pi)\frac{\pi^{\frac{2}{\beta}} - 1}{\pi^{\frac{2}{\beta}}} \equiv v_m(\pi, \beta). \tag{A.11}$$

Similar to the benchmark model, we have $v_m(\pi_a) < v(\pi_a)$, $v_m'(\pi) > 0$ and $\lim_{\pi\to\infty} v_m(\pi) > v(\pi_a)$. Hence, there exists a critical $\pi_m > \pi_a$ such that social welfare under the constraint that 50 percent of the population must be skilled for a majority of voters to support the trade reform is higher (lower) in the open than the closed economy if $\pi > (<)\pi_m$. For the relative price to support diversification in the open economy, it must be furthermore true that $\pi < [\beta/(1 - \beta)]^\beta$, which requires that β is sufficiently high. Looking finally at the case of trade in tasks, we find, similar to the benchmark model, that the government cannot obtain support for the trade reform by the majority of the electorate, unless it implements a different schooling system that provides less specialized skills. Summing up, we can therefore conclude that the results from the main text extend to a model variant, in which skilled and unskilled workers are used for task production, provided that the cost share of unskilled workers is sufficiently low.

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