Trade Liberalization, Welfare Prediction, and Political Conflicts*

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Abstract

This paper analyzes *ex ante* trade preferences and the source of potential political conflicts regarding trade liberalization, by developing a dynamic extension of the traditional Heckscher-Ohlin model with imperfect labor mobility. Tracking overall dynamic paths from an arbitrary state to the post-reform steady state under rational expectation, we demonstrate *ex ante* trade preferences associated with trade liberalization and the implied patterns of potential political conflict crucially depend on not only factor endowment but also initial sectoral allocation of workers. That the latter can affect whether bilateral free trade agreements are welcomed (opposed) by the majority of workers as well as investors in a capital-abundant (labor-abundant) country is inconsistent with the welfare prediction by Stolper and Samuelson (1941). Our simulation experiments further reveal that preannounced and delayed implementation, although they cannot make Pareto improvement in either country, can nevertheless facilitate a bilateral free trade agreement by partially redistributing short-run transitional gains and losses so as to persuade the losers in the labor-abundant country to support the reform without affecting the beneficiaries' trade preferences.

Keywords: trade liberalization, trade preferences, transition dynamics
imperfect labor mobility

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1 Introduction

Traditional trade theory stresses 'gains from trade' based on static or comparative static analysis. Trade economists observe, however, that such theoretical predictions, because they fail to consider that long-run consequences may differ from short-run outcomes,[1] and that benefits and costs are not equally distributed at any given time, are incapable of reflecting public fear and political debates regarding trade liberalization. Among the most important issues related to trade liberalization in democratic countries are individuals' *ex ante* trade preferences as well as the welfare implications of trade reform. Central issues for policy makers in democratic countries are likely to take the form of the questions, "Who and how many people will be made better-off by trade liberalization?" and "What might persuade potential losers?" To analyze trade preferences and the source of potential political conflicts associated with trade liberalization, we develop a dynamic extension of the traditional Heckscher-Ohlin framework by incorporating the concept of imperfect mobility of labor.

Interestingly, strong political resistance to, and demonstrations against, the South Korea-US Free Trade Agreement (hereafter, FTA) have emanated from the majority of South Korean rather than US workers, despite comparative advantage in the labor-intensive sector being perceived to lie with South Korea and in the capital-intensive sector with the United States. Similar paradoxical responses were also observed in the FTA between the EU and South Korea, although it did not include an organized political demonstrations.[2] In addition, the majority of South Korean workers did not oppose the Chile-South Korea FTA, despite public expectations of South Korea's comparative disadvantage in the labor-intensive sector. The Stolper and Samuelson (1941) doctrine that holds that the abundant factor would be better off and the scarce factor would be harmed does not seem to account for these patterns of political conflict. Such failure in the predictive ability of traditional trade theory can be largely attributed to the assumption of immediate full employment, which, in ignoring not only the dynamics of frictional transition, but also the initial sectoral allocation of productive resources, promotes the (somewhat casual) argument that welfare consequences are solely determined by factor endowment.

This paper sheds light on the transition dynamics by departing from the traditional approach in taking into account rigidity in labor mobility both within and across sectors.[3] Individual economic agents' *ex ante* trade preferences are determined by whether they expect to benefit or be harmed by a proposed trade reform. To determine expected winners and losers requires solving for their lifetime values backward from post-reform convergence to implementation including the entire transition path between these two points. Comparing lifetime values before and after implementation is different from comparing lifetime values pre- and post-reform steady states, as is usual in comparative statics analysis. Aggregate preferences are different from aggregate welfare implications, moreover, in that the former put equal weight on individual preferences as the

[1] Keynes (1923) opines thoughtfully *"The long run is a misleading guide to current affairs. In the long run we are all dead."*

[2] It is perhaps because attention was diverted by the overlap with the South Korea-US FTA.

[3] Rigidity within sector is caused by search friction as in Diamond (1982), Mortensen (1982), and Pissarides (1985). Rigidity across sector is consequent to inter-sectoral migration barrier including cultural barrier (Hayashi and Prescott (2008)), switching cost (Lee and Wolpin (2006) and Kennan and Walker (2011)), and specific skills (Larch and Lechthaler (2011)).

principle of majority rule. It is natural to expect trade reforms generating large groups of losers to encounter strong political objections in democratic countries.

This paper proposes a dynamic general equilibrium model that consists of two countries, two sectors, and two factors.[4] The input factors are labor, provided by workers, and capital, provided by investors. Investors also use labor and capital to produce products in the respective sectors. They can sell their products in either domestic market or foreign market. Economic agents consume composite goods of these sectoral products. Market participants are price-takers, and prices determined by market clearing conditions in all except the labor market, which is subject to search and matching friction,[5] as in Mortensen and Pissarides (1994) and the inter-sectoral labor barrier (i.e., switching cost)[6] as in Artuç, Chaudhuri, and McLaren (2010). Following Helpman, Itskhoki, and Redding (2010) and Felbermayr, Prat, and Schmerer (2011), we assume wages to be determined according to the bargaining rule proposed by Stole and Zwiebel (1996). In our dynamic extension, investors' vacancy creation decision and workers' inter-sectoral migration decision are forward-looking variables with their own convergence points. That other laws of motion evolve forward from their own initial values towards convergence points keeps this from becoming an initial value problem (IVP). Given the complexity of the problem, we numerically solve the transition path from an (arbitrary) initial state to the post-reform steady state by iterating the forward- and backward-shooting algorithms, as originally proposed in Lipton, Poterba, Sachs, and Summers (1982) and applied in Artuç, Chaudhuri, and McLaren (2008).

Under the perfect mobility assumption, and as predicted by Stolper and Samuelson (1941), individual workers' lifetime value is independent of sector such that all workers in the capital-abundant (labor-abundant) country are worse-off (better-off). When imperfect mobility is considered, however, lifetime value varies across time, sector, and employment status, rendering Stolper and Samuelson (1941) no longer applicable. Moreover, average lifetime value of workers in a given country may increase (decrease) even when the majority of its workers are worse-off (better-off). Hence, welfare-improving trade reform may not only fail to acquire a strong political constituency among, but also even encounter political resistance from, the majority of workers.[7] To identify aggregate preferences with respect to trade reform, we calculate the changes in individual workers' lifetime values and count the number of potential winners and losers on the day of implementation.

[4] Davidson, Martin, and Matusz (1988) develop a two-sector general equilibrium model in which equilibrium unemployment arises endogenously due to search friction in one sectoral labor market. Hosios (1990) presents a similar two-sector model in which both sectoral labor markets are subject to search friction.

[5] Davidson, Martin, and Matusz (1999), by incorporating search friction into the two-country, two-sector, and two-factor trade model, show that a country with better matching efficiency specializes in the sector with a higher rate of separation and consequently endures a higher steady state unemployment rate. Helpman and Itskhoki (2010), Helpman, Itskhoki, and Redding (2010), and Felbermayr, Prat, and Schmerer (2011) incorporate search friction into the monopolistic competition model proposed by Melitz (2003) to analyze the relationship between trade and unemployment. Using cross-nation panel data, Dutt, Mitra, and Ranjan (2009) find trade liberalization to increase unemployment in the short-run, but lower it in the long-run.

[6] Wacziarg and Wallack (2004)'s analysis of 25 trade liberalization episodes demonstrates empirically that the flow of migrant workers across sectors in the first five years after trade liberalization is not very significant. Artuç, Chaudhuri, and McLaren (2010) estimate the mean and variance of workers' switching costs based on US Current Population Surveys.

[7] By extending Davidson, Martin, and Matusz (1999), Magee, Davidson, and Matusz (2005) show that trade preferences can be affected by the rate of turnover.

In our numerical experiments, rapid adjustments in capital immediately after trade liberalization cause wages to discretely increase in the exporting sectors and decline in the importing sectors of both countries. Wages subsequently gradually decline in the capital-abundant country, and rise in the labor-abundant country toward the post-reform steady state regardless of sectors. Depending on the extent of labor immobility, the welfare consequences may or may not be same across sectors within each country. But in any cases, the initial sectoral allocation, because it influences whether the bilateral FTA is welcomed (opposed) by the majority of workers and investors in the capital-abundant (labor-abundant) country, is a primary determinant of aggregate trade preferences. A bilateral FTA can garner a broad political constituency in both countries only when each specializes in the sector in which it is supposed to continuously specialize after the agreement. A country that has an excessive mass of workers in the sector that should be reduced post agreement may encounter strong objections from the majority of workers. It gives a partial answer on why the South Korea-US FTA encountered strong objections in South Korea, whereas the Chile-South Korea FTA did not.

Dehejia (2003) argues that gradual liberalization[8] in a labor-rich small economy with convex moving cost for labor can make import-competing workers beneficiaries rather than losers. Artuç, Chaudhuri, and McLaren (2008), however, find the delayed liberalization to be ineffective in softening political resistance in a large portion of the parameter space.[9] The present paper examines the impact of preannounced and delayed liberalization. Setting an effective length of grace period reduces both *short-run* losses in the importing sector and gains in the exporting sector by delaying their realization and allowing adjustment in advance. This redistributing aspect facilitates trade liberalization in our model's labor-abundant country by persuading potential losers to support reform coupled with a grace period. It is not effective, however, in persuading the expected losers in the capital-abundant country, who are expecting losses in the long as well as short run. In the Heckscher-Ohlin framework with imperfect labor mobility, because workers in the importing sector of the capital-abundant country cannot be beneficiaries, preannounced and delayed implementation cannot affect their trade preferences, even though it improves aggregate welfare by delaying realization of expected losses of workers in the capital-abundant country. This result is consistent with the conjecture by Artuç, Chaudhuri, and McLaren (2008) that gradual trade liberalization may not work in a capital-rich counterpart of Dehejia (2003)'s economy.

The paper proceeds as follows. We develop the model in Section 2 and address the patterns of trade preferences and potential political conflicts under different initial states in Section 3. The impact of preannounced and delayed implementation is also discussed in Section 3. Section 4 concludes.

[8] Mussa (1978), Furusawa and Lai (1999) and Bond and Park (2002) investigate whether the gradual trade liberalization can achieve socially efficient outcomes in different settings. Naoi and Okazaki (2013) analyze how the Japanese government overcame the political conflicts and implemented trade reform in the 1960s using two tactics, "sequencing" and "side-payments" to buy support from legislators. The former involved implementing a different delayed schedule of liberalization for each commodity.

[9] Artuç, Chaudhuri, and McLaren (2008) introduce inter-sectoral labor barriers borrowed from the literature on discrete choice. Using a model of a small open economy, they show that with inter-sectoral labor barriers, preannouncing and delaying liberalization can build or destroy a constituency for supporting free trade depending on the parameter values.

2 The Model

2.1 Primitives

Consider a world economy consisting of two countries, home and foreign, with all foreign parameters and variables designated by an overhead tilde ($\sim$). Each country is populated by two types of economic agents, L-measure of workers and ε-measure of investors. Workers (investors) in both countries are endowed with one unit of labor (capital) flow at every instant.[10] Workers provide labor and receive wages in the labor market. Investors, by trading capital and employing labor, produce final products to take the profit flow. Throughout the paper, we have used the feminine pronoun to refer to an investor and the masculine pronoun to a worker. To embed comparative advantage based on initial endowment, let

$$L = \tilde{L} = 1, \quad \varepsilon = 1.5, \quad \text{and} \quad \tilde{\varepsilon} = 0.5.$$

By construction, the home country is capital-abundant and the foreign country is labor-abundant. The home (foreign) country has a comparative advantage in the capital- (labor-) intensive sector. All agents consume composite goods of both sectoral products using their income. In each country, there are two sectors, labor intensive sector ($i = 1$) and capital intensive sector ($i = 2$). The investor in each sector purchases capital and labor from the factor markets to produce sectoral products. She can sell her products either in home or foreign market. All markets except the labor markets are competitive since the market participants are price-takers. The labor markets in both countries are subject to search and matching friction as in Mortensen and Pissarides (1994). Time is continuous and all households discount future at rate r. In what follows, given the symmetry assumption we proceed mainly with the home country when it is innocuous to do so.

Workers A worker (an investor as well) consumes composite goods of both sectoral products. The composite goods, which can be used for production as well as consumption, are assembled under perfect competition in the way of minimizing the assembling cost, $p^c_{1t}\hat{q}_{1t} + p^c_{2t}\hat{q}_{2t}$, subject to

$$(\hat{q}_{1t}^{\frac{\sigma-1}{\sigma}} + \hat{q}_{2t}^{\frac{\sigma-1}{\sigma}})^{\frac{\sigma}{\sigma-1}} = 1, \tag{1}$$

where (p^c_{1t}, p^c_{2t}) represent the after-tax prices of the sectoral products at time t, and $(\hat{q}_{1t}, \hat{q}_{2t})$ the quantity demanded for each sectoral products to produce one unit of the composite goods. The elasticity of substitution parameter σ is assumed to be strictly positive.[11] Let P_t be the total assembling cost per unit. Under perfect competition, it should be same to the retail price of the composite goods. Also, let W_t and q_{it} be the aggregate income and the aggregate demand for the intermediate goods i at time t, respectively. Solving the cost minimization problem yields

$$q_{it} = (p^c_{it})^{-\sigma} W_t P_t^{\sigma-1}, \quad \text{where} \quad P_t = \left((p^c_{1t})^{1-\sigma} + (p^c_{2t})^{1-\sigma}\right)^{\frac{1}{1-\sigma}}. \tag{2}$$

[10] This is related to ‘Lucas tree’. Investors retain their own ‘Lucas tree’ from which they get ‘capital flow’ at every instant.

[11] Refer to Arrow, Chenery, Minhas, and Solow (1961) as for the property of constant elasticity of substation (CES) functions.

In what follows, we take the composite goods as *numéraire* and normalize P_t to be unity. As a result, the implied indirect utility flow of each worker or investor with income flow w per instant is obtained by wP_t^{-1}.

A worker is either employed or unemployed. In order to keep the steady state measure of population, it is assumed that a worker newly-born in sector i enters the sectoral labor market as a successor of a retiree from sector i. However, it is allowed for him to immediately switch to the other sector if he wants.[12] Let V_{it} and E_{it} be the lifetime value of unemployment in sector $i \in \{1,2\}$ at time $t \in [0,\infty)$ and that of employment, respectively. A worker newly-born in sector i at time $t \in [0,\infty)$ chooses sector i if $V_{it} \geq V_{i't} - \epsilon$ and otherwise sector i', where $\epsilon \sim Logistic(0, \xi^{-1})$. Then the probability that the newly-born worker in sector i chooses sector i' is denoted by

$$\omega_{i't} = \frac{\exp(\xi(V_{i't} - V_{it}))}{1 + \exp(\xi(V_{i't} - V_{it}))} = 1 - \omega_{it}, \quad \text{where} \quad i \neq i'. \tag{3}$$

As the value differential $V_{i't} - V_{it}$ rises, he is more likely to switch. Note that as ξ goes to ∞, $\omega_{i't}$ converges to 0 or 1 depending on the sign of $(V_{i't} - V_{it})$.

An unemployed worker in sector i receives unemployment benefit b_t per instant and looks for a job offer. He also gets a chance to switch to other sector $i'(\neq i)$ at rate μ.[13] Once he is hit by the migration shock, he redraws $\epsilon \sim Logistic(0, \xi^{-1})$ and switches to sector i' only if $V_{i't} - \epsilon > V_{it}$, which is same as newly-born workers. Therefore, the actual switching rate by an incumbent is $\mu\omega_{i't}$. Denote by $\Delta_{i't}$ the unconditional expected surplus from inter-sectoral migration. We obtain

$$\Delta_{i't} = E[\max\{V_{i't} - V_{it} - \epsilon, 0\}] = \xi^{-1}\log(1 + \exp[\xi(V_{i't} - V_{it})]) \tag{4}$$

following Mcfadden (1974) and Rust (1987). The Hamilton-Jacobi-Bellman (HJB hereafter) equation for the unemployed worker in sector i is given by

$$rV_{it} = (b_t - \ell_t)P_t^{-1} - \rho V_{it} + f(\theta_{it})(E_{it} - V_{it}) + \mu\Delta_{i't} + \dot{V}_{it}, \tag{5}$$

where ℓ_t represents the lump-sum tax defined in nominal terms to all workers for the unemployment insurance system and $f(\theta_{it})$ represents the job finding rate in sector i at time t. The left-hand side can be interpreted as the opportunity cost of holding asset, unemployment in sector i at time t. The terms on the right-hand side represent the benefit flow from holding asset V_{it} which consists of dividend flow from the asset, potential loss from retirement, as well as potential gains from job finding, inter-sectoral migration, and changes in valuation of the asset, respectively.

When a worker is employed in sector i, he receives wage flow w_{it} per instant. The employed worker retires at rate ρ and is separated from the job at rate δ due to an exogenous shock. The HJB equation for the employed worker in sector i is given by

$$rE_{it} = (w_{it} - \ell_t)P_t^{-1} - \rho E_{it} + \delta(V_{it} - E_{it}) + \dot{E}_{it}. \tag{6}$$

[12] We borrow this idea from Oh and Sim (2013). In their model, a newly-born worker, as a successor of a retiree from the agricultural (or manufacturing) sector, is born in the agricultural (manufacturing) area, but he can choose in which sectoral labor market he starts his career. Consequently, $\omega_{it}\rho L$- measure of newly-born workers enter the labor market of sector i per instant.

[13] One may think of different arrival rates of the revision shock across sectors. If we differentiate the arrival rates, the computation becomes more expensive because it is required to apply an additional loop. Thus, for simplicity, we assume that the arrival rates are same across sectors. However, the actual switching rates are completely different across sectors because of ω_{it}.

Again, the left-hand side represents the opportunity cost of holding asset E_{it}. The right-hand side consists of the dividend flow from the asset, potential loss from retirement and job separation, and gains from changes in valuation of the asset, respectively.

Investors In sector i of each country, there is ε_i measure of entrepreneurs having the same preferences as the workers.[14] By construction, $\varepsilon_1 + \varepsilon_2 = \varepsilon$. It is assumed that each investor owns and manages a firm (or a workplace) to maximize her own value of the indirect utility flow. All investors in sector i produce homogeneous sectoral products using identical production technology which is denoted by

$$y_{it} = k_{it}^{1-\beta_i} h_{it}^{\beta_i}, \tag{7}$$

where k_{it} and h_{it} represent the unit of capital and the number of workers employed by the investors, respectively. It is assumed that $\beta_i \in (0, 1)$ and $\beta_1 > \beta_2$.

The employed workers leave their investors at rate $\rho + \delta$. In order to hire workers, investors should create vacancies at cost $\eta_t (= \eta P_t)$ per vacancy and wait for job seekers due to the search and matching friction in the labor market. Let v_{it} be the number of vacancies that each investor in sector i creates per instant. Each vacancy is filled up by a worker at rate $q(\theta_{it})$. The measure of employees under a particular investor in sector i evolves as follows.

$$\dot{h}_{it} \;=\; -(\delta + \rho) h_{it} + q(\theta_{it}) v_{it}, \quad \text{for each} \;\; i = 1, 2. \tag{8}$$

Finally, the operating profit in each sector is summarized by

$$\pi_{it} = p_{it} k_{it}^{1-\beta_i} h_{it}^{\beta_i} - \gamma_{it}(k_{it} - 1) - w_{it} h_{it} - \eta P_t v_{it}. \tag{9}$$

The investor having $\overline{h}$ workers in sector i at time t sets a future investment-employment plan (k_{is}, v_{is}) for each $s \in [t, \infty)$ to maximize

$$\int_t^\infty e^{-r(s-t)} \pi_{is} P_s^{-1} ds \tag{10}$$

subject to

$$\begin{aligned} \dot{h}_{is} &= -(\delta + \rho) h_{is} + q(\theta_{is}) v_{is} \\ h_{it} &= \overline{h} \end{aligned}$$

At every instant, an investor makes the factor-purchasing decision first and then negotiates with her employees at the production stage. When making the factor-purchasing decision, she also considers how her decision may affect the wage bargaining outcome, which will be given in the next paragraph. In the factor market, an individual investor

[14] The mass of investors has no effect on the equilibrium outcome and welfare consequence of workers due to the linearity of the problem. If we put a small number for ε_i, the value of each investor in sector i increases. This paper will not consider trade preferences of investors by assuming a sufficiently small ε_i. In addition, to abstract from another discussion on altruistic behavior, we simply assume that all entrepreneurs are fully altruistic so that they transfer everything without discount to their kids when they die.

is a price-taker. $J_{it}(\overline{h})$ denotes the expected value of the investor in sector i at time t having $\overline{h}$ employees. Solving Hamiltonian yields

$$\eta = q(\theta_{it})\frac{\partial J_{it}}{\partial h_{it}} \quad \text{and} \tag{11}$$

$$\gamma_{it} = \frac{(1-\phi)(1-\beta_i)p_{it}}{1-\phi+\phi\beta_i}k_{it}^{-\beta_i}h_{it}^{\beta_i} \tag{12}$$

for each $t \in [0,\infty)$. A detailed derivation of (11) and (12) is described in Appendix A.2. In (11), the left-hand side represents the (marginal) cost of creating a vacancy in terms of indirect utility and the right-hand side is the expected gain from creating the vacancy. In equation (12), ϕ denotes the bargaining power parameter in wage setting proposed by Stole and Zwiebel (1996), which will be presented in the next paragraph. The left-hand side represents the marginal cost of capital and the right-hand side represents marginal value of capital. Given an optimal schedule of $\{k_{is}, v_{is}\}_{s\in[t,\infty)}$, we obtain the marginal value equation of the investor,

$$\frac{d}{dt}\Big(\frac{\partial J_{it}}{\partial h_{it}}\Big) = (r+\rho+\delta)\frac{\partial J_{it}}{\partial h_{it}} - p_{it}\frac{\partial y_{it}}{\partial h_{it}} + w_{it} + \frac{\partial w_{it}}{\partial h_{it}}h_{it}. \tag{13}$$

Wage Determination Wages are determined by the intra-firm bargaining mechanism proposed by Stole and Zwiebel (1996). Let $\phi \in (0,1)$ be the share of the marginal surplus of the match given to an employed worker.[15] The investor collects $(1-\phi)$ portion of the marginal surplus from each match. Then,

$$(1-\phi)(E_{it}-V_{it}) = \phi\frac{\partial J_{it}}{\partial h_{it}} \quad \text{and} \quad (1-\phi)(\dot{E}_{it}-\dot{V}_{it}) = \phi\frac{d}{dt}\Big(\frac{\partial J_{it}}{\partial h_{it}}\Big) \tag{14}$$

From (11), we get $\frac{\partial J_{it}}{\partial h_{it}} > 0$ at any time. Thus, (14) requires that for each $i \in \{1,2\}$,

$$E_{it} > V_{it}, \quad \text{at every} \quad t \in [0,\infty). \tag{15}$$

Note that this restriction matters significantly under some parameter values because of the gains from inter-sectoral migration by the unemployed.

Combining (5), (6), (11), (13), and (14) altogether and solving the differential equation results in

$$w_{it} = \frac{\phi p_{it}(\partial y_{it}/\partial h_{it})}{1-\phi+\phi\beta_i} + (1-\phi)b_t + \eta P_t\phi\theta_{it} + (1-\phi)\mu\Delta_{i't}P_t. \tag{16}$$

Interestingly, the first term on the right-hand side depends on the marginal product of labor and the other terms depend on the external conditions such as $(b, \theta_{it}, V_{i't} - V_{it})$. Again, a detailed derivation of (16) is described in Appendix A.1.

The unemployed workers receive the unemployment insurance, which is financed by the (nominal) lump-sum tax ℓ_t from all workers. The government budget balancing implies that

$$\ell_t L = \sum_{i=1,2} u_{it}b_t. \tag{17}$$

[15] One can think sector-specific bargaining powers of workers. At least in qualitative research, it does not create a big difference. But since it is too difficult to justify the choice of different bargaining shares, this paper assumes that the share of the worker is same across sectors just for simplicity.

Factor Markets There are two factor markets in each country, capital market and labor market. International borrowing or lending and international migration are precluded throughout the paper. In each country, there is only one unified market for capital. All investors should trade capital goods through the capital market at the same price, *i.e* $\gamma_{1t} = \gamma_{2t} = \gamma_t$ at every instant. The total supply of capital goods is fixed, while the demand for capital is described by (12) and (16). Equating the demand and supply yields

$$\varepsilon = \varepsilon_1 \Big[\frac{(1-\phi)(1-\beta_1)p_{1t}}{(1-\phi+\phi\beta_1)\gamma_t} \Big]^{\frac{1}{\beta_1}} h_{1t} + \varepsilon_2 \Big[\frac{(1-\phi)(1-\beta_2)p_{2t}}{(1-\phi+\phi\beta_2)\gamma_t} \Big]^{\frac{1}{\beta_2}} h_{2t}. \tag{18}$$

Given $(p_{it}, p_{i't}, h_{it}, h_{i't})$, equation (18) determines the price of capital γ_t and $(k_{it}, k_{i't})$ as well. the derivation of equation (18) is presented at the end of Appendix A.2.

The labor market in each country is segmented by sector. Each sectoral sub-market is subject to search and matching friction. Let u_{it} be the measure of unemployed workers in sector i at time t. The labor market tightness parameter in sector i at time t can be defined as

$$\theta_{it} := \frac{\varepsilon_i v_{it}}{u_{it}}. \tag{19}$$

Given constant returns to scale matching technology, $m(\varepsilon_i v_{it}, u_{it})$, the job-filling rate of a vacancy and the job-finding rate by a job searcher in sector i at time t are given by

$$q(\theta_{it}) = m(1, \theta_{it}^{-1}) \quad \text{and} \quad f(\theta_{it}) = m(\theta_{it}, 1) = \theta_{it} q(\theta_{it}). \tag{20}$$

In the numerical experiments in Section 3, we use a common Cobb-Douglas matching function for all labor markets:

$$m(\varepsilon_i v_{it}, u_{it}) = \lambda(\varepsilon_i v_i)^{1-\kappa} u_i^{\kappa}, \quad \text{where} \quad \lambda > 0 \quad \text{and} \quad \kappa \in (0,1). \tag{21}$$

H_{it} denotes the population employed in sector i at time t, respectively. By construction, $H_{it} = \varepsilon_i h_{it}$ and $H_{1t} + H_{2t} + u_{1t} + u_{2t} = L$ at any time. The population size of each group evolves as follows.

$$\dot{H}_{it} = -(\rho+\delta)H_{it} + f(\theta_{it})u_{it} \tag{22}$$

$$\dot{u}_{it} = -(f(\theta_{it}) + \mu\omega_{i't} + \rho)u_{it} + \delta H_{it} + \mu\omega_{it}u_{i't} + \rho\omega_{it}L. \tag{23}$$

Product Markets Let us use superscript f to indicate the prices received by foreign investors. For example, p_{it}^f represents the price received by a foreign investor in sector i in the home market at time t, while $\tilde{p}_{it}^f$ represents the price received by the same investor in the foreign market. The theory of comparative advantage dictates that the home country exports capital intensive products $i = 2$ to the foreign country and imports labor intensive products $i = 1$ from the foreign country in a trade equilibrium. Then,

$$p_{1t}^c = p_{1t} = (1+\tau)p_{1t}^f = (1+\tau)\tilde{p}_{1t}^f = (1+\tau)\tilde{p}_{1t}^c. \tag{24}$$

The first equal sign suggests that the price paid by domestic consumers is exactly the same as the price received by domestic producers in home country regardless of the tariff. The second one reflects the fact that foreign producers should receive less than home producers in the home market in the presence of tariff. The third one indicates that a foreign investor receives the same price per unit in both home and foreign markets, otherwise, all products will be sold only in one market. The last one implies that the price paid by foreign consumers should be the same as the price received by foreign investors in foreign markets regardless of the tariff. Based on the same rationale as above, we get

$$(1+\tilde{\tau})p_{2t}^{c} = (1+\tilde{\tau})p_{2t} = (1+\tilde{\tau})\tilde{p}_{2t} = \tilde{p}_{2t}^{f} = \tilde{p}_{2t}^{c}. \tag{25}$$

For expositional convenience, define

$$p_t := \frac{p_{2t}}{p_{1t}}, \tag{26}$$

at each time t. Denote by χ_{2t} the exporting decision by the domestic investors in sector $i = 2$, the proportion of the capital intensive goods exporting to the foreign market. Similarly, $\tilde{\chi}_{1t}$ represents the proportion of foreign labor intensive products imported to the home market. The aggregate revenue of the home and foreign country at time t is given by

$$W_t = \sum_{i=1,2} \varepsilon_i p_{it} y_{it} + \tau\tilde{\chi}_{1t}\tilde{\varepsilon}_1\tilde{p}_{1t}\tilde{y}_{1t} = p_{1t}\Big[\varepsilon_1 y_{1t} + p_t\varepsilon_2 y_{2t} + \frac{\tau\tilde{\chi}_{1t}\tilde{\varepsilon}_1\tilde{y}_{1t}}{1+\tau}\Big], \quad \text{and} \tag{27}$$

$$\tilde{W}_t = \sum_{i=1,2} \tilde{\varepsilon}_i\tilde{p}_{it}\tilde{y}_{it} + \tilde{\tau}\chi_{2t}\varepsilon_2 p_{2t} y_{2t} = p_{1t}\Big[\frac{\tilde{\varepsilon}_1\tilde{y}_{1t}}{1+\tau} + \tilde{\varepsilon}_2(1+\tilde{\tau})p_t\tilde{y}_{2t} + \tilde{\tau}p_t\chi_{2t}\varepsilon_2 y_{2t}\Big], \tag{28}$$

respectively. By equating the aggregate demand and supply of agricultural products in each market, we obtain the market clearing condition as follows.

$$\varepsilon_1 y_{1t} + \tilde{\chi}_{1t}\tilde{\varepsilon}_1\tilde{y}_{1t} = p_{1t}^{-\sigma} W_t P_t^{\sigma-1} = p_{1t}^{-1} W_t (1+p_t^{1-\sigma})^{-1}, \quad \text{and} \tag{29}$$

$$(1-\tilde{\chi}_{1t})\tilde{\varepsilon}_1\tilde{y}_{1t} = (p_{1t}/(1+\tau))^{-\sigma}\tilde{W}_t\tilde{P}_t^{\sigma-1} \tag{30}$$

By summing up equations (29) and (30), we can get the world market clearing condition for the labor intensive products.

$$\varepsilon_1 y_{1t} + \tilde{\varepsilon}_1\tilde{y}_{1t} = p_{1t}^{-\sigma} W_t P_t^{\sigma-1} + (p_{1t}/(1+\tau))^{-\sigma}\tilde{W}_t\tilde{P}_t^{\sigma-1} \tag{31}$$

In addition, combining (27) and (29) and reordering yields

$$W_t = p_{1t}\Big[\frac{\varepsilon_1 y_{1t}}{1+\tau} + p_t\varepsilon_2 y_{2t}\Big]\Big[1 - \frac{\tau}{(1+\tau)(1+p_t^{1-\sigma})}\Big]^{-1}. \tag{32}$$

The same rationale is applied to the markets for capital intensive products. By equating the supply and demand in each market and summing up, we obtain

$$(1-\chi_{2t})\varepsilon_2 y_{2t} = p_{2t}^{-\sigma} W_t P_t^{\sigma-1}, \tag{33}$$

$$\chi_{2t}\varepsilon_2 y_{2t} + \tilde{\varepsilon}_2\tilde{y}_{2t} = ((1+\tilde{\tau})p_{2t})^{-\sigma}\tilde{W}_t\tilde{P}_t^{\sigma-1}, \quad \text{and} \tag{34}$$

$$\varepsilon_2 y_{2t} + \tilde{\varepsilon}_2\tilde{y}_{2t} = p_{2t}^{-\sigma} W_t P_t^{\sigma-1} + ((1+\tilde{\tau})p_{2t})^{-\sigma}\tilde{W}_t\tilde{P}_t^{\sigma-1}. \tag{35}$$

Combining (28) and (34) yields

$$\tilde{W}_t = p_{1t}\Big[\frac{\tilde{\varepsilon}_1\tilde{y}_{1t}}{1+\tau} + p_t\tilde{\varepsilon}_2\tilde{y}_{2t}\Big]\Big[1 - \frac{\tilde{\tau}p_t^{1-\sigma}}{(1+\tilde{\tau})^{\sigma}[(1+\tau)^{\sigma-1} + ((1+\tilde{\tau})p_t)^{1-\sigma}]}\Big]^{-1}. \quad (36)$$

Taking the ratio of (31) to (35), replacing all foreign prices with home prices and tariff rates, and reordering yields

$$\frac{\varepsilon_1 y_{1t} + \tilde{\varepsilon}_1\tilde{y}_{1t}}{\varepsilon_2 y_{2t} + \tilde{\varepsilon}_2\tilde{y}_{2t}} = p_t^{\sigma}\Big[\frac{W_t/(1+p_t^{1-\sigma}) + (1+\tau)^{\sigma}\tilde{W}_t/\big((1+\tau)^{\sigma-1} + ((1+\tilde{\tau})p_t)^{1-\sigma}\big)}{W_t/(1+p_t^{1-\sigma}) + (1+\tilde{\tau})^{-\sigma}\tilde{W}_t/\big((1+\tau)^{\sigma-1} + ((1+\tilde{\tau})p_t)^{1-\sigma}\big)}\Big]. \quad (37)$$

Equation (37) implies that when $\tau = \tilde{\tau} = 0$, the relative price is determined solely by the sectoral output ratio. By plugging (32) and (36) into (37) and removing p_{1t}, we obtain p_t, and in turns, (p_{1t}, p_{2t}) using (2). Then, by substituting (p_{1t}, p_{2t}) into (30) and (33), we also obtain $(\chi_{2t}, \tilde{\chi}_{1t})$. Finally, it is required that for each country,

$$\chi_{2t}, \tilde{\chi}_{1t} \in [0,1) \quad \text{at every} \quad t \in [0,\infty). \quad (38)$$

Trade Equilibrium The following definition summarizes the overall shape of our model.

A *trade equilibrium* for the world economy with tariff $(\tau, \tilde{\tau})$ consists of bounded time series of choice rules $\{c_{it}, \tilde{c}_{it}, k_{it}, \tilde{k}_{it}, v_{it}, \tilde{v}_{it}\}_{i=1,2}$, labor market tightness parameters $\{\theta_{it}, \tilde{\theta}_{it}\}_{i=1,2}$, price vector $\{p_{it}, \tilde{p}_{it}, \gamma_{it}, \tilde{\gamma}_{it}, w_{it}, \tilde{w}_{it}\}_{i=1,2}$, profit flow $\{\pi_{it}, \tilde{\pi}_{it}\}_{i=1,2}$, value equations $\{E_{it}, \tilde{E}_{it}, V_{it}, \tilde{V}_{it}, \frac{\partial J_{it}}{\partial h_{it}}, \frac{\partial \tilde{J}_{it}}{\partial h_{it}}\}_{i=1,2}$, and measures $\{H_{it}, \tilde{H}_{it}, h_{it}, \tilde{h}_{it}, u_{it}, \tilde{u}_{it}\}_{i=1,2}$ at every $t \in [0,\infty)$ such that:

- (i) Each worker and investor in home (foreign) country optimally chooses $\{c_{1t}, c_{2t}\}$ ($\{\tilde{c}_{1t}, \tilde{c}_{2t}\}$) at every t.
- (ii) Each investor in sector i in home (foreign) country optimally chooses $\{k_{it}, v_{it}\}$ ($\{\tilde{k}_{it}, \tilde{v}_{it}\}$) at every t. It also determines $\{\pi_{it}, \tilde{\pi}_{it}\}_{i=1,2}$ at every t.
- (iii) The market tightness $\{\theta_{it}, \tilde{\theta}_{it}\}_{i=1,2}$ in (19) should be consistent with the vacancy creation condition in (11) and the unemployment rate $\{u_{it}, \tilde{u}_{it}\}_{i=1,2}$.
- (iv) The world market clearing condition in (37) together with (2), (32), and (36), and the wage setting rule in (16) jointly determine $\{p_{it}, \tilde{p}_{it}, \gamma_{it}, \tilde{\gamma}_{it}, w_{it}, \tilde{w}_{it}\}_{i=1,2}$ at every t. By construction, $p_{1t} = (1+\tau)\tilde{p}_{1t}$, $(1+\tilde{\tau})p_{2t} = \tilde{p}_{2t}$, $\gamma_{1t} = \gamma_{2t}$, and $\tilde{\gamma}_{1t} = \tilde{\gamma}_{2t}$.
- (v) The evolution of the entire system is recursively governed by the law of motion of (5), (6), (13), (22), and (23) given $\{E_{i0}, \tilde{E}_{i0}, V_{i0}, \tilde{V}_{i0}, \frac{\partial J_{i0}}{\partial h_{i0}}, \frac{\partial \tilde{J}_{i0}}{\partial h_{i0}}\}_{i=1,2}$ and $\{H_{i0}, \tilde{H}_{i0}, u_{i0}, \tilde{u}_{i0}\}_{i=1,2}$.
- (vi) The equilibrium restrictions described in (15) and (38) should be satisfied.

In addition, when either $\chi_{2t} < 0$ or $\tilde{\chi}_{1t} < 0$ at any $t \in [0,\infty)$, we set $\chi_{2t} = \tilde{\chi}_{1t} = 0$ and call it an autarky equilibrium. [Figure 1] in Appendix B, especially the flat parts of the curves, show that when the tariffs rates are high, the countries choose an autarky equilibrium rather than a trade equilibrium as a long-run equilibrium.

2.2 Characterization of Transition Dynamics

In this subsection, we characterize the transition path to the post-reform steady state after mutual tariff cuts.

Lemma 1 *Given $\{E_{it}, V_{it}, H_{it}, u_{it}\}_{i=1,2}$ at every instant, we obtain that for each $i \in \{1,2\}$,*

$$\begin{aligned}
\theta_{it} &= q^{-1}\Big(\frac{\eta\phi}{(1-\phi)(E_{it}-V_{it})}\Big) \\
k_{it} &= \Big[\frac{(1-\phi)(1-\beta_i)p_{it}}{(1-\phi+\phi\beta_i)\gamma_{it}}\Big]^{\frac{1}{\beta_i}} h_{it} \\
y_{it} &= \Big[\frac{(1-\phi)(1-\beta_i)p_{it}}{(1-\phi+\phi\beta_i)\gamma_{it}}\Big]^{\frac{1-\beta_i}{\beta_i}} h_{it} \\
v_{it} &= \theta_{it}u_{it}/\varepsilon_i, \quad \textit{and} \\
w_{it} &= \frac{\phi p_{it}\beta_i}{1-\phi+\phi\beta_i}\Big[\frac{(1-\phi)(1-\beta_i)p_{it}}{(1-\phi+\phi\beta_i)\gamma_{it}}\Big]^{\frac{1-\beta_i}{\beta_i}} + (1-\phi)b_t + \eta P_t\phi\theta_{it} + (1-\phi)\mu\Delta_{i't}P_t
\end{aligned}$$

where γ_t is implicitly given by the capital market clearing condition in equation (18). In addition, given $\{\tilde{E}_{it}, \tilde{V}_{it}, \tilde{H}_{it}, \tilde{u}_{it}\}_{i=1,2}$, we can apply the same equations to the foreign variables. Then, the world market clearing conditions presented in (31) and (35) jointly solve for (p_{1t}, p_{2t}).

Lemma 1 tells us that the entire system is governed by the system of differential equations of $\{E_{it}, V_{it}, H_{it}, u_{it}\}_{i=1,2}$ and $\{\tilde{E}_{it}, \tilde{V}_{it}, \tilde{H}_{it}, \tilde{u}_{it}\}_{i=1,2}$. Once these values are given at particular time t, we can solve for all relevant variables at the moment,[16] which enables us to redefine them as functions of $\{E_{it}, \tilde{E}_{it}, V_{it}, \tilde{V}_{it}, H_{it}, \tilde{H}_{it}, u_{it}, \tilde{u}_{it}\}_{i=1,2}$ or simply time t (autonomous control).

Proposition 1 *Given Lemma 1, the transition path can be summarized in the following system of differential equations.*

$$\begin{aligned}
\dot{H}_{it} &= -(\rho+\delta)H_{it} + f(\theta_{it})u_{it}, && (39) \\
\dot{u}_{it} &= -(f(\theta_{it}) + \mu\omega_{i't} + \rho)u_{it} + \delta H_{it} + \mu\omega_{it}u_{i't} + \rho\omega_{it}L, && (40) \\
\dot{V}_{it} &= (r+\rho)V_{it} - (b_t - \ell_t)P_t^{-1} - f(\theta_{it})(E_{it}-V_{it}) - \mu\Delta_{i't}, \quad \textit{and} && (41) \\
\dot{E}_{it} &= (r+\rho+\delta)E_{it} - \delta V_{it} - (w_{it} - \ell_t)P_t^{-1}, && (42)
\end{aligned}$$

where (H_{i0}, u_{i0}) are given at the date of implementation, $b_t = \ell_t L/(u_{1t}+u_{2t})$, and

$$\lim_{t\to\infty}(H_{it}, u_{it}, V_{it}, E_{it}) = (H_i, u_i, V_i, E_i). \tag{43}$$

In addition, the similar system of differential equations and the boundary conditions apply to the foreign country.

Throughout the paper all values on steady states are denoted with no time subscript. If the values of $\{E_{i0}, \tilde{E}_{i0}, V_{i0}, \tilde{V}_{i0}\}_{i=1,2}$ are available, the entire system described

[16] The existence and uniqueness of the solution is not clear, since Lemma 3 heavily relies on the non-linear system of equations.

in Proposition 1 becomes an initial value problem with variables coefficients. However, since the lifetime values are forward-looking variables, they are immediately adjusted with discrete jumps right after the trade reform and start their journey along the gradual transition path toward the post-reform steady state. Under rational expectation, the post-reform steady state variables are fully expected but the entire duration of the transition is unknown. Moreover, the lifetime values gradually converge but they do not hit the exact post-reform steady state values. It prevents the analytical description on the transition path.

Now, consider the post reform steady state. It is required that the law of motion described in the definition of equilibrium should be stationary on steady states. That is, for each $i = 1, 2$,

$$H_{it} = H_i, \quad u_{it} = u_i, \quad E_{it} = E_i, \quad V_{it} = V_i, \quad \text{and} \quad \frac{\partial J_{it}}{\partial h_{it}} = \frac{\partial J_i}{\partial h_i}. \tag{44}$$

It implies that on steady states,

$$\begin{aligned} 0 &= -(\rho+\delta)H_i + f(\theta_{it})u_i, \quad \text{and} &(45)\\ 0 &= -(f(\theta_{it}) + \mu\omega_{i't} + \rho)u_i + \delta H_i + \mu\omega_{it}u_{i'} + \rho\omega_{it}L. &(46)\end{aligned}$$

From (45) and (46), we obtain that $(\theta_{it}, \omega_{it})$ are constant overtime on steady states. That is, $(\theta_{it}, \omega_{it}) = (\theta_i, \omega_i)$ on steady states.

Lemma 2 *Suppose that there exists a steady state and the steady state values of $\{p_i, \theta_i\}_{i=1,2}$ are given. The inter-sectoral migration of the worker is characterized by*

$$\omega_i = \Big[1 + \exp\Big(-\frac{\xi\eta\phi(\theta_i - \theta_{i'})}{(r+\rho+\mu)(1-\phi)}\Big)\Big]^{-1} = 1 - \omega_{i'}. \tag{47}$$

In particular, the migration decision together with the market tightness forms the steady state measure of workers as follows. For each $i \in \{1, 2\}$,

$$\begin{aligned} u_i &= \frac{\rho\omega_i L\Big[\frac{f(\theta_{i'})\rho}{\rho+\delta} + \mu\omega_i + \rho + \mu\omega_{i'}\Big]}{\Big[(\frac{f(\theta_i)\rho}{\rho+\delta} + \mu\omega_{i'} + \rho)(\frac{f(\theta_{i'})\rho}{\rho+\delta} + \mu\omega_i + \rho) - \mu\omega_{i'}\mu\omega_i\Big]}, \quad \textit{and} &(48)\\ H_i &= \frac{f(\theta_i)\rho\omega_i L\Big[\frac{f(\theta_{i'})\rho}{\rho+\delta} + \mu\omega_i + \rho + \mu\omega_{i'}\Big]}{(\rho+\delta)\Big[(\frac{f(\theta_i)\rho}{\rho+\delta} + \mu\omega_{i'} + \rho)(\frac{f(\theta_{i'})\rho}{\rho+\delta} + \mu\omega_i + \rho) - \mu\omega_{i'}\mu\omega_i\Big]}. &(49)\end{aligned}$$

The same argument applies to the foreign country.

The mathematical proof of Lemma 2 is presented in Appendix A.3. Lemma 2 implies that once $\{p_i, \theta_i\}_{i=1,2}$ are given, the steady state measures are determined. In case of the foreign country, we should replace L with $\tilde{L}$ in equations (48) and (49). Then, the government budget balancing implies that

$$b = \ell L/(u_1 + u_2) \tag{50}$$

Lemma 3 *Given $(p_1, p_2, \theta_1, \theta_2)$ on steady state, the investor employing h_i optimally chooses k_i such that*

$$k_i = \Big[\frac{(1-\phi)(1-\beta_i)p_i}{(1-\phi+\phi\beta_i)\gamma}\Big]^{\frac{1}{\beta_i}} h_i, \tag{51}$$

where γ is implicitly defined in

$$\Big[\frac{(1-\phi)(1-\beta_1)p_1}{(1-\phi+\phi\beta_1)\gamma}\Big]^{\frac{1}{\beta_1}} H_1 + \Big[\frac{(1-\phi)(1-\beta_2)p_2}{(1-\phi+\phi\beta_2)\gamma}\Big]^{\frac{1}{\beta_2}} H_2 = K. \tag{52}$$

It also implies that

$$y_i = \Big[\frac{(1-\phi)(1-\beta_i)p_i}{(1-\phi+\phi\beta_i)\gamma}\Big]^{\frac{1-\beta_i}{\beta_i}} h_i, \quad \textit{and} \tag{53}$$

$$w_i = \frac{\phi p_i \beta_i}{1-\phi+\phi\beta_i}\Big[\frac{(1-\phi)(1-\beta_i)p_i}{(1-\phi+\phi\beta_i)\gamma}\Big]^{\frac{1-\beta_i}{\beta_i}} + (1-\phi)b + \eta P\phi\theta_i + (1-\phi)\mu\Delta_{i't}P \tag{54}$$

Again, the same argument applies to the foreign country.

Note that the left-hand side in (52) is continuous and strictly increasing in γ. Also it goes to zero when γ goes to ∞, and ∞ when γ goes to zero. As long as K is strictly positive, γ is uniquely determined by (52). The investor also makes vacancy creation decision at every instant by equating the marginal benefit of creating vacancy and the marginal cost of doing so.

$$\frac{\eta P(r+\rho+\delta)}{q(\theta_i)} = \frac{(1-\phi)\beta_i p_i}{1-\phi+\phi\beta_i}\Big(\frac{k_i}{h_i}\Big)^{1-\beta_i} - (1-\phi)b - \eta P\phi\theta_i - (1-\phi)\mu\Delta_{i'}P \tag{55}$$

Due to the linear property of the vacancy creation cost, it results in the optimal relationship between h_i and θ_i. Plugging (51) into (55) and reordering yields

$$\frac{\beta_i p_i}{1-\phi+\phi\beta_i}\Big[\frac{(1-\phi)(1-\beta_i)p_i}{(1-\phi+\phi\beta_i)\gamma}\Big]^{\frac{1-\beta_i}{\beta_i}} = \frac{\eta P(r+\rho+\delta)}{(1-\phi)q(\theta_i)} + \frac{\eta P\phi\theta_i}{(1-\phi)} + b + \mu\Delta_{i'}P \tag{56}$$

for each $i \in \{1,2\}$. Given (p_1, p_2), equation (56) implicitly solves for θ_i. While the left-hand side is independent of θ_i, the right-hand side is strictly increasing in θ_i. Although we are not able to ensure that the joint solution (θ_1, θ_2) always exists, we can rewrite the solution of (56) as a function of (p_1, p_2), if it exists.

$$(\theta_1, \theta_2) = (\theta_1(p_1, p_2), \theta_2(p_1, p_2)) \tag{57}$$

Since $H_i = \varepsilon_i h_i$, we get (h_i, k_i) from (49) and (51). Then, all endogenous variables associated with both home and foreign countries immediately follow. Given (p_1, p_2, y_1, y_2) and $p = p_1/p_2$, the aggregate incomes are obtained by

$$W = p_1\Big[\frac{\varepsilon_1 y_1}{1+\tau} + p\varepsilon_2 y_2\Big]\Big[1 - \frac{\tau}{(1+\tau)(1+p^{1-\sigma})}\Big]^{-1}, \quad \textit{and} \tag{58}$$

$$\tilde{W} = p_1\Big[\frac{\tilde{\varepsilon}_1\tilde{y}_1}{1+\tau} + p\tilde{\varepsilon}_2\tilde{y}_2\Big]\Big[1 - \frac{\tilde{\tau}p^{1-\sigma}}{(1+\tilde{\tau})^{\sigma}[(1+\tau)^{\sigma-1} + ((1+\tilde{\tau})p)^{1-\sigma}]}\Big]^{-1}. \tag{59}$$

The remaining task is to determine (p_1, p_2) (and $(\tilde{p}_1, \tilde{p}_2) = (p_1/(1+\tau), p_2(1+\tilde{\tau}))$). The following proposition presents the condition for the existence of a steady state.

Proposition 2 *Let $p = p_2/p_1$ and $P = (p_1^{1-\sigma} + p_2^{1-\sigma})^{\frac{1}{1-\sigma}} = 1$. There exists a steady state if and only if the following system of non-linear equations has a solution of $\{p_1, p_2, \theta_1, \theta_2, \tilde{\theta}_1, \tilde{\theta}_2\}$, and the solution satisfies the equilibrium restrictions (15) and (38).*

$$(i) \quad \frac{\varepsilon_1 y_1 + \tilde{\varepsilon}_1 \tilde{y}_1}{\varepsilon_2 y_2 + \tilde{\varepsilon}_2 \tilde{y}_2} = p^\sigma \Big[\frac{W/(1+p^{1-\sigma}) + (1+\tau)^\sigma \tilde{W} / \big((1+\tau)^{\sigma-1} + ((1+\tilde{\tau})p)^{1-\sigma} \big)}{W/(1+p^{1-\sigma}) + (1+\tilde{\tau})^{-\sigma} \tilde{W} / \big((1+\tau)^{\sigma-1} + ((1+\tilde{\tau})p)^{1-\sigma} \big)} \Big]. \tag{60}$$

$$(ii) \quad \frac{(1-\phi)\beta_i p_i}{(1-\phi+\phi\beta_i)} \Big(\frac{(1-\phi)(1-\beta_i)p_i}{(1-\phi+\phi\beta_i)\gamma} \Big)^{\frac{1-\beta_i}{\beta_i}} = \frac{\eta P (r+\rho+\delta)}{q(\theta_i)} + (1-\phi)b + \eta P \phi \theta_i + (1-\phi)\mu \Delta_{i'} P, \tag{61}$$

for each $i \in \{1, 2\}$ and each country.

Proposition 2 tells us that the analytic proof of the existence and uniqueness of our steady state trade (autarky) equilibrium pins down to the 6-dimensional system of non-linear equations. But it is still challenging to solve the system due to the large dimension of the model and some implicit conditions of the equilibrium. Furthermore, to describe the entire dynamic path is almost infeasible. Given the complexity of the whole system, we replace the analytical proof of the existence and uniqueness result with numerical experiments with different initial values. Instead, we acknowledge that given the set of parameters, the same result was obtained from all our attempts to execute the numerical code with more than 20 different random initial paths. To explain them in great detail, we present our calibration strategy, solution algorithms, and numerical results in Appendix B. In the subsequent section, we directly move onto interpretation of our numerical results.

3 Trade Preferences and Political Conflicts

The usual welfare analysis using comparative statics analysis in terms of aggregate lifetime values is not persuasive, as the post-reform steady state values do not include the foregone cost and benefit an individual agent incurs in transition.[17] Second, the weighted average of lifetime value in the post-reform steady state does not take into account that workers selectively switch to the "better-paying" sector. Ignoring the endogenous selection procedure biases the comparative static analysis towards trade reform. Moreover, the simple average of lifetime value allows different weights on individual trade preferences, which violates the majority rule and democratism.

We focus in what follows on trade preferences and welfare of workers. Because their population is small relative to that of workers, investors' preferences and welfare analysis are dropped. In addition, the welfare implication of investors is anyway trivially the same as the prediction by Stolper and Samuelson (1941) without friction. We

[17]It creates the value differentials between the second and third column in [Table 1].

label as '*winners*' ('*losers*') those whose expected lifetime value upon implementation of trade reform is anticipated to be higher (lower). We determine winners and losers by tracking changes in lifetime value, then count the numbers of winners and losers to gauge how many workers are expected to be better and worse off. Following the majority rule, we infer the magnitude of potential political conflict.

We analyze in section 3.1 the *ex ante* trade preferences[18] of individual workers by comparing their lifetime values before and after trade liberalization at an initial steady state with tariff 0.05. This approach assumes the economy to be at the (pre-reform) steady state before trade liberalization. The problem with this assumption is that, because workers' endogenous selection results in the majority of workers being concentrated in the exporting sector even in the pre-reform steady state, it may overlook the length and magnitude of structural adjustment. In practice, economies are not necessarily in the steady state at the time of trade reform. We analyze in section 3.2 trade preferences and potential political conflicts associated with reform imposed in an arbitrary state. Specifically, we investigate four representative cases with different initial distributions of workers. This requires that we solve for the transition dynamics twice, first, from the initial state to the pre-reform steady state, and then from the initial state to the post-reform steady state. In section 3.3, we examine the effect of pre-announced and delayed implementation, which presumes some interval between the signing (or initial discussion) and enactment of a trade liberalization agreement. Pre-announcement enables economic agents to anticipate and make adjustments for trade reform in advance. We assume here, for purposes of discussion, an agreement between home and foreign countries to completely eliminate tariffs with a three-year delay.

3.1 Trade Liberalization in the Initial Steady States

[Table 1] reports results with different $\xi = 1.0, 0.5$, and 0.05. The first four rows in each panel correspond to the subgroups of workers, the fifth presents their weighted averages. For each country, the first column shows the lifetime value of each subgroup in the pre-reform steady state. Simultaneously eliminating tariffs in both countries changes the future expectation of all economic agents, immediately moves the mass of capital goods, and creates discrete jumps in all forward-looking variables at implementation. Lifetime values immediately after reform are given in the second column for each country. As workers are progressively reallocated to the comparative advantage sector, the economy converges gradually to a new steady state. Lifetime values in the post-reform steady state are presented in the third column for each country. The absolute values in the fourth column represent the masses of each subgroup in the pre-reform steady state. Winners and losers are denoted by positive and negative signs, respectively. The fifth row in the last column reports a proportional expression of winners to losers.

When ξ is sufficiently large (*i.e.* $\xi = 1.0$ in [Table 1]) to render workers' migration decisions sensitive enough to the lifetime value differentials, all workers in the capital-abundant home country are worse off in the post-reform steady state. This is consistent with the prediction of Stolper and Samuelson (1941). As ξ sufficiently declines (*i.e.* $\xi = 0.05$ in [Table 1]) to render the migration decision less sensitive to the value differentials, all workers in the exporting sector of each country are better off and those in the importing sector worse off. These results show the perfect mobility assumption

[18] The concept of "trade preferences" is borrowed from Magee, Davidson, and Matusz (2005).

to be the crucial to deriving Stolper and Samuelson (1941).

More important, the dynamic behavior of lifetime value is time-inconsistent. In Panel A, in which $\xi = 1.0$, the foreign workers in sector 2 are worse off on the day of implementation, although they are expected to be better off in the long run (regardless where they go). In other words, 27% of foreign workers are hurt at implementation, and half of these move to the other sector, whereupon the remaining workers in sector 2 enjoy higher values. In Panel B, in which $\xi = 0.5$, most outcomes are same as in Panel A except that the foreign country faces more opponents as it has more workers in the pre-reform steady state. In Panel C, the home country workers in sector 2 and foreign country workers in sector 1 working in the exporting sectors are better off in both the short and long run after trade liberalization. An interesting case appears when ξ lies between 0.5 or 0.05, although it is dropped in [Table 1] due to space limitations. For example, when $\xi = 0.25$, the home workers in sector 2 are better off on the day of implementation and worse off at the post-reform steady state, while the foreign workers in sector 2 are worse off on the day of implementation and better off at the post-reform steady state. This implies that the home country workers in sector 2 enjoy the temporary rent before other workers come into the sector. This suggests, interestingly, that the majority of workers in the capital-abundant country can be supportive of trade reform even though they expect to be worse off in the long run.

3.2 Trade Liberalization on an Arbitrary Transition Path

[Table 2] represents, as above, the lifetime values on the transition path and associated trade preferences. The sensitivity parameter of the migration decision, ξ, is fixed at 0.5 for both countries. Note that due to space limitations, we drop the lifetime values of investors, which are trivial. As a baseline, Panel D assigns slightly more masses to the comparative advantage sectors, while keeping aggregate unemployment at 0.06 for both countries, such that

$$(u_1, H_1, u_2, H_2) = (0.03, 0.46, 0.03, 0.48), \ (\tilde{u}_1, \tilde{H}_1, \tilde{u}_2, \tilde{H}_2) = (0.03, 0.48, 0.03, 0.46).$$

Workers in the exporting sector expect gains, workers in the importing sector losses, from trade reform. More workers being initially in the comparative advantage sector, the majority of workers in both the capital-abundant home, and labor-abundant foreign, country agree to the trade reform.

The allocation pattern of workers in the initial state not necessarily being consistent with their comparative advantage, Panel E puts more masses in the comparative disadvantage sector, resulting in

$$(u_1, H_1, u_2, H_2) = (0.03, 0.48, 0.03, 0.46), \ (\tilde{u}_1, \tilde{H}_1, \tilde{u}_2, \tilde{H}_2) = (0.03, 0.46, 0.03, 0.48).$$

Both countries having more workers in the importing sector, the majority of workers incur losses upon implementation of trade reform.

Panels F and G analyze the effect of trade liberalization when both countries put more resources in the same sector. Panel F assumes as the initial state,

$$(u_1, H_1, u_2, H_2) = (0.03, 0.46, 0.03, 0.48) = (\tilde{u}_1, \tilde{H}_1, \tilde{u}_2, \tilde{H}_2),$$

which analyzes the liberalization episode between two developed countries that keep larger masses in the capital-intensive sector. Panel F partially answers why the trade liberalization may encounter political conflict in one but not in the other of two developed countries. Although both, being developed countries, rely on the capital-intensive sector, one country should have comparative advantage in the labor-intensive sector. The theory of comparative advantage dictates that the majority of workers in the country in which they switch to the labor-intensive sector are worse off, and the majority of workers in the other country better off. This helps to explain why the South Korea-US FTA, but not FTAs with Chile and other relatively labor-abundant countries, were *ex ante* protested by the majority of workers in labor-abundant South Korea.

Panel G, which assumes

$$(u_1, H_1, u_2, H_2) = (0.03, 0.48, 0.03, 0.46) = (\tilde{u}_1, \tilde{H}_1, \tilde{u}_2, \tilde{H}_2),$$

analyzes the liberalization episode between two developing countries that keep larger masses in the labor intensive sectors. In this instance, the majority of workers are worse off in the home, and better off in the foreign, country. This being obvious in the sense that the majority of workers is retained in the importing sector in the home, and in the exporting sector in the foreign, country, stronger political objections to mutual trade reform are more likely to be experienced in the home than in the foreign country.

3.3 Pre-announced and Delayed Liberalization

At [Table 1 and 2], the lifetime values at the reform coupled with a three-year grace period are presented in the parentheses. Proportion of winners in parentheses also represents trade preferences for the reform with the grace period. Preannouncing and delaying the reform, by postponing realization of gains and losses and allowing anticipatory adjustment, reduces in the exporting, and increases in the importing, sector workers' lifetime value. The reform, being one of surplus-redistribution policies, cannot yield Pareto improvement among the workers in both countries. Partially redistributing the expected surplus, however, may be sufficient to persuade the potential losers to support the trade reform. For example, in Panel A of [Table 1], foreign workers in sector 2 are expected to be losers upon implementation of the trade reform, but become beneficiaries with the introduction of the three-year grace period. The labor-abundant foreign country could thereby arrive at a unanimous consensus among all workers.

In Panel D of [Table 2], both countries having slightly more workers in their comparative advantage sectors *ex ante*. By continuously specializing in the sectors in which they have more masses, both countries can avoid potential objections by the majority of workers even without a grace period. Introducing the grace period in this case may affect the welfare of individual workers, but does not negatively affect trade preferences. In Panels E and F of [Table 2], having at implementation slightly more workers in its comparative disadvantage sector incurs short-run transitional losses for the foreign country. Sudden implementation may incur political objections from the majority of workers, as can be seen in the results without grace period, but by preannouncing and delaying trade reform, the foreign country can achieve consensus among all workers. All Panels D, E, F and G in [Table 2] show preannounced and delayed implementation to be ineffective at persuading the capital-abundant home country workers who expect losses in both the short and long run. Introducing a grace period is thus effective only in persuading the workers who expect losses in the short run, but sufficient gains in long run or after switching to the other sector. Our simulation experiments universally show preannounced and delayed implementation to be unable to change the trade preferences of the capital-abundant home country workers, who are expected to be worse off in the long run in both sectors. Preannounced and delayed implementation is effective, however, in persuading the foreign country workers in the comparative disadvantage sector, who are expected to be better off in the long run.

Table 1: Welfare and Trade Preferences of Trade Reform

	Home				Foreign			
	lifetime values			proportion of winners (+) losers (−)	lifetime values			proportion of winners (+) losers (−)
	before	at reform	after		before	at reform	after	
	Panel A: $\xi = 1.0$							
u_1	46.37	43.37 (43.91)	42.51	(−) 1 ((−) 1)	33.58	35.97 (35.56)	37.01	(+) 5 ((+) 5)
H_1	46.83	43.76 (44.34)	42.89	(−)16 ((−) 16)	33.97	36.38 (35.94)	37.44	(+)68 ((+) 68)
u_2	47.92	47.84 (47.65)	46.19	(−) 5 ((−) 5)	32.59	32.59 (32.96)	34.84	(−) 2 ((+) 2)
H_2	48.42	48.35 (48.15)	46.67	(−)77 ((−) 77)	32.94	32.89 (33.29)	35.20	(−)25 ((+) 25)
Total Workers	48.11	47.52 (47.46)	46.55	0 : 100 (0 : 100)	33.66	35.41 (35.20)	37.18	73 : 27 (100 : 0)
	Panel B: $\xi = 0.5$							
u_1	46.78	43.98 (44.51)	43.19	(−) 2 ((−) 2)	32.95	35.36 (34.92)	36.17	(+) 5 ((+) 5)
H_1	47.23	44.37 (44.94)	43.57	(−)22 ((−) 22)	33.32	35.76 (35.30)	36.58	(+)62 ((+) 62)
u_2	49.16	49.05 (48.86)	47.54	(−) 5 ((−) 5)	31.56	31.33 (31.66)	33.09	(−) 2 ((+) 2)
H_2	49.67	49.58 (49.37)	48.04	(−)72 ((−) 72)	31.89	31.61 (31.96)	33.42	(−)31 ((+) 31)
Total Workers	49.07	48.34 (48.31)	47.56	0 : 100 (0 : 100)	32.82	34.36 (34.17)	36.00	67 : 33 (100 : 0)
	Panel C: $\xi = 0.05$							
u_1	48.46	46.41 (46.86)	46.17	(−) 3 ((−) 3)	32.41	34.49 (34.03)	34.68	(+) 5 ((+) 5)
H_1	48.70	46.59 (47.08)	46.35	(−)37 ((−) 37)	32.58	34.71 (34.22)	34.91	(+)47 ((+) 47)
u_2	55.28	56.00 (55.76)	55.38	(+) 4 ((+) 4)	31.63	30.91 (31.15)	31.25	(−) 5 ((−) 5)
H_2	55.72	56.48 (56.21)	55.85	(+)55 ((+) 55)	31.76	30.98 (31.25)	31.34	(−)44 ((−) 44)
Total Workers	52.85	52.44 (52.48)	52.29	59 : 41 (59 : 41)	32.16	32.88 (32.76)	33.33	51 : 49 (51 : 49)

The values in parentheses are obtained under the 3-year grace period.

Table 2: Welfare and Trade Preferences for Different Initial States ($\xi = 0.5$)

	Home				Foreign			
	lifetime values			proportion of	lifetime values			proportion of
	before	at reform	after	winners (+) losers (−)	before	at reform	after	winners (+) losers (−)
	Panel D: $(u_1, H_1, u_2, H_2) = (0.03, 0.46, 0.03, 0.48)$ and $(\tilde{u}_1, \tilde{H}_1, \tilde{u}_2, \tilde{H}_2) = (0.03, 0.48, 0.03, 0.46)$							
u_1	46.75	44.15 (44.58)	43.19	(−) 3 ((−) 3)	31.26	33.48 (33.04)	36.17	(+) 3 ((+) 3)
H_1	47.12	44.45 (44.92)	43.57	(−)46 ((−) 46)	31.57	33.83 (33.36)	36.58	(+)48 ((+) 48)
u_2	53.14	53.72 (53.42)	47.54	(+) 3 ((+) 3)	30.49	30.39 (30.65)	33.09	(−) 3 ((+) 3)
H_2	53.74	54.34 (54.02)	48.04	(+)48 ((+) 48)	30.80	30.66 (30.95)	33.42	(−)46 ((+) 46)
Workers	50.47	49.47 (49.53)	47.56	51 : 49 (51 : 49)	31.18	32.26 (32.16)	36.00	51 : 49 (100 : 0)
	Panel E: $(u_1, H_1, u_2, H_2) = (0.03, 0.48, 0.03, 0.46)$ and $(\tilde{u}_1, \tilde{H}_1, \tilde{u}_2, \tilde{H}_2) = (0.03, 0.46, 0.03, 0.48)$							
u_1	46.78	44.23 (44.64)	43.19	(−) 3 ((−) 3)	31.15	33.34 (32.91)	36.17	(+) 3 ((+) 3)
H_1	47.15	44.53 (44.96)	43.57	(−)48 ((−) 48)	31.46	33.68 (33.23)	36.58	(+)46 ((+) 46)
u_2	53.55	54.16 (53.86)	47.54	(+) 3 ((+) 3)	30.32	30.25 (30.49)	33.09	(−) 3 ((+) 3)
H_2	54.16	54.79 (54.48)	48.04	(+)46 ((+) 46)	30.63	30.51 (30.78)	33.42	(−)48 ((+) 48)
Workers	50.55	49.53 (49.60)	47.56	49 : 51 (49 : 51)	31.02	32.05 (31.96)	36.00	49 : 51 (100 : 0)
	Panel F: $(u_1, H_1, u_2, H_2) = (0.03, 0.46, 0.03, 0.48) = (\tilde{u}_1, \tilde{H}_1, \tilde{u}_2, \tilde{H}_2)$							
u_1	46.89	44.30 (44.73)	43.19	(−) 3 ((−) 3)	31.28	33.51 (33.07)	36.17	(+) 3 ((+) 3)
H_1	47.26	44.61 (45.07)	43.57	(−)46 ((−) 46)	31.59	33.86 (33.39)	36.58	(+)46 ((+) 46)
u_2	53.08	53.63 (53.33)	47.54	(+) 3 ((+) 3)	30.29	30.19 (30.44)	33.09	(−) 3 ((+) 3)
H_2	53.68	54.25 (53.94)	48.04	(+)48 ((+) 48)	30.59	30.44 (30.72)	33.42	(−)48 ((+) 48)
Workers	50.51	49.50 (49.56)	47.56	51 : 49 (51 : 49)	31.07	32.10 (32.01)	36.00	49 : 51 (100 : 0)
	Panel G: $(u_1, H_1, u_2, H_2) = (0.03, 0.48, 0.03, 0.46) = (\tilde{u}_1, \tilde{H}_1, \tilde{u}_2, \tilde{H}_2)$							
u_1	46.67	44.08 (44.50)	43.19	(−) 3 ((−) 3)	31.12	33.30 (32.87)	36.17	(+) 3 ((+) 3)
H_1	47.03	44.37 (44.83)	43.57	(−)48 ((−) 48)	31.43	33.65 (33.19)	36.58	(+)48 ((+) 48)
u_2	53.59	54.26 (53.94)	47.54	(+) 3 ((+) 3)	30.54	30.45 (30.71)	33.09	(−) 3 ((+) 3)
H_2	54.21	54.89 (54.55)	48.04	(+)46 ((+) 46)	30.85	30.73 (31.01)	33.42	(−)46 ((+) 46)
Workers	50.52	49.50 (49.57)	47.56	49 : 51 (49 : 51)	31.13	32.20 (32.10)	36.00	51 : 49 (100 : 0)

The values in parentheses are obtained under the 3-year grace period.

4 Conclusion

Their significance notwithstanding, trade preferences and political conflicts associated with trade liberalization have not been properly treated in the previous literature. Previous research that has examined the long-run welfare consequences of trade liberalization using comparative statics analysis is silent on *ex ante* trade preferences and political debates regarding who and how many may benefit from the potential trade reform. Such issues require consideration of the entire transition path from an initial state to the post-reform steady state under rational expectation. To address those issues and identify sources of potential political conflict, we propose a dynamic extension of the canonical Heckscher-Ohlin framework that takes into account imperfect labor mobility.

This paper demonstrates that when the inter-sectoral migration decision is not sufficiently sensitive to the value differentials across sectors, the theory of Stolper and Samuelson (1941) is no longer applicable because the paths of the lifetime values of workers in each sector differ. In particular, trade preferences are determined not only by factor endowment, as in Stolper and Samuelson (1941), but also by initial sectoral allocation. A bilateral FTA can garner a broad political constituency in both countries only when each specializes in the sector in which it is supposed to continuously specialize after the agreement. A country that has an excessive mass of workers in the sector that should be reduced post agreement may encounter strong objections from the majority of workers.

Preannounced and delayed implementation can improve aggregate welfare in one country, but not in both countries simultaneously. It can also mitigate potential political conflicts and foster acceptance of bilateral FTAs by delaying and partially redistributing short-run transitional gains and losses. A policy of redistribution can persuade workers worried about transitional losses in the short run to support trade reform at the cost of beneficiaries' expected gains. Our simulation experiments reveal that introducing into the traditional Heckscher-Ohlin model a grace period of effective length can mitigate aggregate welfare losses (gains) in the capital-abundant (labor-abundant) country, but can affect trade preferences and soften potential political conflicts only in the labor-abundant country, which is partially consistent with the result of Dehejia (2003) and the counterargument to it by Artuç, Chaudhuri, and McLaren (2008).

For policy makers and trade researchers, the framework proposed in this paper can be extended to such other interesting considerations as how to choose a free-trading partner, how to determine the optimal duration of the grace period, and how to order bilateral free trade agreements among multiple trading partners. Given the complexity of the issues, these remain fruitful avenues for future research. We further hope that aggregate preferences at the implementation point receive more attention in policy analysis than aggregate welfare based on comparative statics.

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Appendices

A Mathematical Appendix

A.1 Wage Determination

From (5), (6) and (13), we obtain

$$\begin{aligned}
\dot{E}_{it} &= (r+\rho+\delta)E_{it} - (w_{it}-\ell)P_t^{-1} - \delta V_{it}, && \text{(A1)}\\
\dot{V}_{it} &= (r+\rho)V_{it} - (b_t-\ell)P_t^{-1} - f(\theta_{it})(E_{it}-V_{it}) - \mu\Delta_{i't}, \quad \text{and} && \text{(A2)}\\
\dot{J}^h_{it} &= (r+\rho+\delta)J^h_{it} - [p_{it}\frac{\partial y_{it}}{\partial h_{it}} - w_{it} - \frac{\partial w_{it}}{\partial h_{it}}h_{it}]P_t^{-1}. && \text{(A3)}
\end{aligned}$$

The intra-firm bargaining rule proposed by Stole and Zwiebel (1996) implies that

$$(1-\phi)(E_{it}-V_{it}) = \phi\frac{\partial J_{it}}{\partial h_{it}} \quad \text{and} \quad (1-\phi)(\dot{E}_{it}-\dot{V}_{it}) = \phi\frac{d}{dt}\Big(\frac{\partial J_{it}}{\partial h_{it}}\Big), \tag{A4}$$

at any $t \in [0,\infty)$. Plugging (A1), (A2), and (A3) to (A4) and reordering yields

$$\begin{aligned}
&\phi[p_{it}\frac{\partial y_{it}}{\partial h_{it}} - w_{it} - \frac{\partial w_{it}}{\partial h_{it}}h_{it}]P_t^{-1}\\
&= (1-\phi)[(w_{it}-b_t)P_t^{-1} - f(\theta_{it})(E_{it}-V_{it}) - \mu\Delta_{i't}]\\
&= (1-\phi)(w_{it}-b_t)P_t^{-1} - \eta\phi\theta_{it} - (1-\phi)\mu\Delta_{i't} && \text{(A5)}
\end{aligned}$$

The last equality follows from

$$\eta = q(\theta_{it})\frac{\partial J_{it}}{\partial h_{it}} = q(\theta_{it})\frac{(1-\phi)(E_{it}-V_{it})}{\phi} \tag{A6}$$

Reordering (A5) yields

$$w_{it} + \frac{\partial w_{it}}{\partial h_{it}}\phi h_{it} = \phi p_{it}\frac{\partial y_{it}}{\partial h_{it}} + (1-\phi)b_t + \eta P_t\phi\theta_{it} + (1-\phi)\mu\Delta_{i't}P_t \tag{A7}$$

Since it should be true for all $t \in [0,\infty)$, the solution of (A7) has the form of

$$w_{it} = B_{it}\frac{\partial y_{it}}{\partial h_{it}} + C_{it}, \tag{A8}$$

where neither B_{it} nor C_{it} depends on h_{it}. Plugging the expression into the above and applying the undetermined coefficient method yields

$$\begin{aligned}
B_{it} &= \frac{\phi p_{it}}{(1-\phi)+\phi\beta_i}, \quad \text{and}\\
C_{it} &= (1-\phi)b_t + \eta P_t\theta_{it}\phi + (1-\phi)\mu\Delta_{i't}P_t.
\end{aligned}$$

Finally, we obtain

$$w_{it} = \frac{\phi p_{it}(\partial y_{it}/\partial h_{it})}{(1-\phi)+\phi\beta_i} + (1-\phi)b_t + \eta P_t\theta_{it}\phi + (1-\phi)\mu\Delta_{i't}P_t \tag{A9}$$

A.2 The Optimal Control by Investors

Consider the optimal control problem of an investor in sector i at time t. The investor chooses (k_{is}, v_{is}) at every $s \in [t, \infty)$ to maximize

$$\int_t^\infty e^{-r(s-t)} \pi_{is} P_s^{-1} ds \tag{A10}$$

subject to

$$\begin{aligned} \dot{h}_{is} &= -(\delta+\rho)h_{is} + q(\theta_{is})v_{is} && \text{(A11)} \\ h_{it} &= \bar{h}_i && \text{(A12)} \end{aligned}$$

Simply, we ignore the restriction on the domain and solve for the optimal control problem. Then, we will check whether the interior solution is obtained. The Hamiltonian for the above problem is

$$\mathcal{H} = e^{-r(s-t)} \pi_{is} P_s^{-1} - x_h[(\delta+\rho)h_{is} - q(\theta_{is})v_{is}].$$

The maximum principle implies that

$$\begin{aligned} k_{is} &: \gamma_i = (1-\beta_i)p_{is}k_{is}^{-\beta_i}h_{is}^{\beta_i}P_s^{-1} - \frac{\partial w_{is}}{\partial k_i}h_{is} && \text{(A13)} \\ v_{is} &: \eta e^{-r(s-t)} = x_h q(\theta_{is}) && \text{(A14)} \\ h_{is} &: \dot{x}_h = -e^{-r(s-t)}P_s^{-1}\frac{\partial \pi_{is}}{\partial h_{is}} + x_h(\delta+\rho) && \text{(A15)} \end{aligned}$$

From (A15),

$$\begin{aligned} & e^{-(\delta+\rho)(s-t)}\dot{x}_h - (\delta+\rho)e^{-(\delta+\rho)(s-t)}x_h = -e^{-(r+\delta+\rho)(s-t)}P_s^{-1}\frac{\partial \pi_{is}}{\partial h_{is}} \\ \iff \quad & e^{-(\delta+\rho)(s-t)}x_h = \int_s^\infty e^{-(r+\delta+\rho)(\tau-t)}P_\tau^{-1}\frac{\partial \pi_{i\tau}}{\partial h_{i\tau}}d\tau + A_{ih} \\ \iff \quad & x_h = e^{(\delta+\rho)(s-t)}\int_s^\infty e^{-(r+\delta+\rho)(\tau-t)}P_\tau^{-1}\frac{\partial \pi_{i\tau}}{\partial h_{i\tau}}d\tau + A_{ih}e^{(\delta+\rho)(s-t)} \end{aligned}$$

Since the shadow price x_h cannot diverge as $s \to \infty$, $A_{ih} = 0$. Thus, we get

$$x_h = e^{(\delta+\rho)(s-t)}\int_s^\infty e^{-(r+\delta+\rho)(\tau-t)}P_\tau^{-1}\frac{\partial \pi_{i\tau}}{\partial h_{i\tau}}d\tau \tag{A16}$$

Plugging (A16) into (A14) and rewriting yields

$$\eta = q(\theta_{is})\int_s^\infty e^{-(r+\delta+\rho)(\tau-s)}P_\tau^{-1}\frac{\partial \pi_{i\tau}}{\partial h_{i\tau}}d\tau \tag{A17}$$

Taking derivative of the objective function with respect to h_i yields

$$\frac{\partial J_{it}}{\partial h_i} = \int_t^\infty e^{-(r+\delta+\rho)(s-t)}P_s^{-1}\frac{\partial \pi_{is}}{\partial h_{is}}ds \tag{A18}$$

Connecting (A17) and (A18) results in

$$\eta = q(\theta_{is})\frac{\partial J_{is}}{\partial h_i} \tag{A19}$$

Pugging (A9) into (A13) and rewriting yields

$$\gamma_{it} = \frac{(1-\phi)(1-\beta_i)}{(1-\phi)+\phi\beta_i}p_{it}k_{it}^{-\beta_i}h_{it}^{\beta_i} \iff k_{it} = \Big[\frac{(1-\phi)(1-\beta_i)p_{it}}{[(1-\phi)+\phi\beta_i]\gamma_{it}}\Big]^{\frac{1}{\beta_i}}h_{it} \tag{A20}$$

A.3 Mathematical Proofs

Proof of Lemma 1 Since we have ε_i-measure of homogenous investors in sector i, we get $H_{it} = \varepsilon_i h_{it}$. Since

$$\eta = q(\theta_{it})\frac{\partial J_{it}}{\partial h_{it}} = q(\theta_{it})\frac{(1-\phi)(E_{it}-V_{it})}{\phi}, \tag{A21}$$

by taking inverse, we get the explicit formula for θ_{it}. Then, from the first order condition by the investor in sector i, we get k_{it} and plug k_{it} into the production function to obtain y_{it}. Then, all the others are straightforward. *Q.E.D.*

Proof of Lemma 2 Since $\dot{V}_{it} = 0$ on steady state, combining (A2) and (A6) yields

$$\begin{aligned}
&(r+\rho)(V_{i'}-V_i)\\
&= \frac{\phi\eta(\theta_{i'}-\theta_i)}{(1-\phi)} + \mu\xi^{-1}\log\{1+\exp[\xi(V_i-V_{i'})]\} - \mu\xi^{-1}\log\{1+\exp[\xi(V_{i'}-V_i)]\}\\
&= \frac{\phi\eta(\theta_{i'}-\theta_i)}{(1-\phi)} + \mu\xi^{-1}\log\left(\frac{1+\exp[\xi(V_i-V_{i'})]}{1+\exp[\xi(V_{i'}-V_i)]}\times\frac{\exp[\xi(V_i-V_{i'})]}{\exp[\xi(V_i-V_{i'})]}\right)\\
&= \frac{\phi\eta(\theta_{i'}-\theta_i)}{(1-\phi)} + \mu\xi^{-1}\log(\exp[\xi(V_i-V_{i'})])\\
&= \frac{\phi\eta(\theta_{i'}-\theta_i)}{(1-\phi)} + \mu(V_i-V_{i'})
\end{aligned}$$

Therefore,

$$V_{i'}-V_i = \frac{\eta\phi(\theta_{i'}-\theta_i)}{(r+\rho+\mu)(1-\phi)} \tag{A22}$$

By plugging (A22) into the migration function, we get (47). Since (H_i, u_i) as well as (θ_i, ω_i) are constant on steady state, we obtain

$$\begin{pmatrix}
\rho+\delta & 0 & -f(\theta_1) & 0\\
0 & \rho+\delta & 0 & -f(\theta_2)\\
-\delta & 0 & f(\theta_1)+\mu\omega_2+\rho & -\mu\omega_1\\
0 & -\delta & -\mu\omega_2 & f(\theta_2)+\mu\omega_1+\rho
\end{pmatrix}
\begin{pmatrix} H_1\\ H_2\\ u_1\\ u_2\end{pmatrix}
=
\begin{pmatrix} 0\\ 0\\ \rho\omega_1 L\\ \rho\omega_2 L\end{pmatrix}$$

Note that the first matrix on the left-hand side is non-singular. Finally, we get (48) and (49), using matrix inversion. *Q.E.D.*

Proof of Lemma 3 From (A20), we get (51). Since $\gamma_i = \gamma_{i'} = \gamma$, $H_i = \varepsilon_i h_i$, and $\varepsilon_i k_i + \varepsilon_{i'} k_{i'} = K$ on steady state, we get

$$\left[\frac{(1-\phi)(1-\beta_1)p_1}{(1-\phi+\phi\beta_1)\gamma}\right]^{\frac{1}{\beta_1}} H_1 + \left[\frac{(1-\phi)(1-\beta_2)p_2}{(1-\phi+\phi\beta_2)\gamma}\right]^{\frac{1}{\beta_2}} H_2 = K. \tag{A23}$$

The left-hand side is strictly decreasing in γ. Moreover, it goes infinity as γ goes to zero, and it goes to zero as γ goes to infinity. Therefore, it uniquely determines γ. Plugging (51) into (7) yields (53). From (A22), we get (54). *Q.E.D.*

Table 3: Baseline Parameterizations (Home)

Parameter	Interpretation	Value
r	quarterly discount rate	0.012
σ	elasticity of substitution parameter	3.8
ρ	retirement rate	0.01
δ	separation rate	0.09
κ	elasticity of matching function	0.72
λ	efficiency of matching function	1.35
η	vacancy creation cost	0.213
$(\ell, \tilde{\ell})$	lump-sum tax	(0.022, 0.017)
ϕ	bargaining weight of worker	0.72
(β_1, β_2)	labor share in each sector	(0.6, 0.4)
μ	the arrival rate of revision shock	0.03
ξ	sensitivity of switching decision	1.0, 0.5, and 0.05

B Numerical Implementation

B.1 Parameterization

Parameter values, chosen following common practice in the literature, are summarized in [Table 3]. To facilitate comparison, all parameters except initial endowment are the same across countries. We fix the quarterly discount rate at 0.012, which is consistent with an annual interest rate of approximately 5%. Elasticity of substitution is fixed at 3.8, following Bernard, Eaton, Jensen, and Kortum (2003), Bernard, Redding, and Schott (2007) and Felbermayr, Prat, and Schmerer (2011). Bernard, Eaton, Jensen, and Kortum (2003) estimate σ using US plant-level manufacturing data. With respect to the labor market, we follow Shimer (2005). He finds that the quarterly separation rate is 0.1 in the U.S. labor market. Because his estimate includes both retirement and separation rates, we impose $\rho + \delta = 0.1$ and set $\delta = 0.09$ and $\rho = 0.01$, which allows workers to work for 25 years before first retirement, and roughly 80% of the workers (entering the labor market at age 25) to retire before reaching age 65. The value of (λ, κ, η) is directly from Shimer (2005). The efficiency and elasticity parameters of the matching function are given by $\lambda = 1.35$ and $\kappa = 0.72$, respectively. The vacancy creation cost η is fixed at 0.213. In Shimer (2005), these values were chosen to obtain an unemployment rate of around 0.06 and job finding rate of approximately 1.35. Following Hosios (1990), we set workers' bargaining weight equal to the elasticity parameter of the matching function, *i.e.*, $\phi = \kappa = 0.72$. Since the lump-sum tax and the unemployment benefits are not our main concern, we fix the (nominal) lump-sum tax at a constant in each country to yield a replacement ratio between 30% and 40% of the average wage, which is around 1. This target results in $(\ell_t, \tilde{\ell}_t) = (\ell, \tilde{\ell}) = (0.022, 0.017)$ forever. If we set $\ell = \tilde{\ell}$, the replacement ratio in the labor-abundant foreign country is much higher than the ratio in the capital-abundant home country. Since it may affect wages, we try to keep the replacement ratio similar across countries rather than the unemployment insurance. Because we consider symmetric differences in country factor endowments $(L, \tilde{L}, K, \tilde{K}) = (1, 1, 1.5, 0.5)$ and factor intensities, we set $(\beta_1, \beta_2) = (0.6, 0.4)$ and the arrival rate of the revision shock at $\mu = 0.03$. Throughout the paper, we perform numerical experiments with $\xi = 1.0, 0.5$, and 0.05 because the steady state measure of workers employed in the comparative advantage sector is about 60% when $\xi = 0.05$ and 90% when $\xi = 1.0$ in the home country.

B.2 Computational Procedures: Steady State

In this subsection, we briefly explain the solution algorithm that we adopt to solve for the steady state equilibrium of our interest.

1. Guess $(p_1, p_2, \theta_1, \theta_2, \tilde{\theta}_1, \tilde{\theta}_2)$. Solve for P using (2).
   (a) Solve for (ω_1, ω_2) using

$$V_1 - V_2 = \frac{\eta\phi(\theta_1 - \theta_2)}{(r + \rho + \mu)(1 - \phi)}, \quad \text{and} \quad \omega_1 = \frac{\exp(\xi(V_1 - V_2))}{1 + \exp(\xi(V_1 - V_2))} = 1 - \omega_2$$

   (b) Solve for (H_1, H_2, u_1, u_2) using

$$\begin{aligned} 0 &= -(\rho + \delta)H_i + f(\theta_i)u_i, \quad \text{and} \\ 0 &= -(f(\theta_i) + \mu\omega_{i'} + \rho)u_i + \delta H_i + \mu\omega_i u_{i'} + \rho\omega_i L. \end{aligned}$$

   Then, by definition, $h_i = H_i/\varepsilon_i$, $v_i = \theta_i u_i/\varepsilon_i$, and $b = \ell L/(u_1 + u_2)$.

   (c) Solve for (γ, k_1, k_2) using

$$\begin{aligned} K &= \varepsilon_1 k_1 + \varepsilon_2 k_2 \quad \text{and} \\ \gamma &= \frac{(1 - \beta_1)(1 - \phi)p_1}{1 - \phi + \phi\beta_1}\Big(\frac{h_1}{k_1}\Big)^{\beta_1} = \frac{(1 - \beta_2)(1 - \phi)p_2}{1 - \phi + \phi\beta_2}\Big(\frac{h_2}{k_2}\Big)^{\beta_2}. \end{aligned}$$

   (d) Solve for $(y_i, y_2, \pi_1, \pi_2, w_1, w_2)$ using

$$\begin{aligned} y_i &= k_i^{1-\beta_i} h_i^{\beta_i}, \\ \pi_i &= p_i y_i - \gamma k_i - w_i h_i - \eta P v_i, \quad \text{and} \\ w_i &= \frac{\phi p_i(\partial y_i/\partial h_i)}{1 - \phi + \phi\beta_i} + (1 - \phi)b + \eta P\phi\theta_i + (1 - \phi)\mu\Delta_{i'}P. \end{aligned}$$

2. Let $(\tilde{p}_1, \tilde{p}_2) = (p_1/(1 + \tau), (1 + \tilde{\tau})p_2)$. Repeat step 1 with the foreign parameters and variables.
3. Update $(p_1, p_2, \theta_1, \theta_2, \tilde{\theta}_1, \tilde{\theta}_2)$ using (60) and (61).

B.3 Computational Procedures: Transition Dynamics

Suppose the economy is in a particular initial state (it can be a steady state or an arbitrary initial state), which is described by $\{H_{i0}, u_{i0}, \tilde{H}_{i0}, \tilde{u}_{i0}\}_{i=1,2}$. At time 0, both countries agree on a mutual tariff cut. Assume that all variables converge to the new steady state after a sufficiently large amount of time (denoted by T). We know all values in the new steady state. However, we don't know the values of the forward-looking variables at time 0 $\{J_{i0}^h, V_{i0}, \tilde{J}_{i0}^h, \tilde{V}_{i0}\}_{i=1,2}$, because they can make a discrete jump right after the mutual tariff cut agreement. Let

$$\begin{aligned}
\vec{m}_t^{(j)} &= (H_{1t}^{(j)}, H_{2t}^{(j)}, u_{1t}^{(j)}, u_{2t}^{(j)}, \tilde{H}_{1t}^{(j)}, \tilde{H}_{2t}^{(j)}, \tilde{u}_{1t}^{(j)}, \tilde{u}_{2t}^{(j)}), \\
\vec{v}_t^{(j)} &= (J_{1t}^{h(j)}, J_{2t}^{h(j)}, V_{1t}^{(j)}, V_{2t}^{(j)}, \tilde{J}_{1t}^{h(j)}, \tilde{J}_{2t}^{h(j)}, \tilde{V}_{1t}^{(j)}, \tilde{V}_{2t}^{(j)}), \quad \text{and} \\
\vec{p}_t^{(j)} &= (\gamma_t^{(j)}, \tilde{\gamma}_t^{(j)}, p_{1t}^{(j)}, p_{2t}^{(j)}),
\end{aligned}$$

where the superscript (j) indicates that the vector is obtained from jth iteration. Note that $\{E_{it}, \tilde{E}_{it}\}_{i=1,2}$ is immediately obtained by (14) once we get $\{J_{it}^h, V_{it}, \tilde{J}_{it}^h, \tilde{V}_{it}\}_{i=1,2}$. We proceed as follows.

1. Set evenly spaced nodes $t_l = \frac{l}{2n}T$ $(l = 0, \ldots, 2n)$.
2. Guess the entire transition path of $(\vec{m}_t^{(0)}, \vec{v}_t^{(0)}, \vec{p}_t^{(0)})$ for every $t \in \{t_l\}_{l=0}^{2n}$. $\vec{m}_0^{(0)}$ should be consistent with the initial state, and $\vec{v}_T^{(0)}$ should have the new steady state value.
3. Repeat the following procedure until $(\vec{m}_t^{(j)}, \vec{v}_t^{(j)}, \vec{p}_t^{(j)})$ converge at each $t \in \{t_l\}_{l=0}^{2n}$.
   (a) Given $(\vec{v}_t^{(j-1)}, \vec{p}_t^{(j-1)})$, solve for new series $\hat{\vec{m}}_t$ by applying forward shooting to(22) and (23). Note that we get θ_{it} by plugging (J_{it}^h, P_t) into (11). Also, ω_{it} is determined by $V_{it} - V_{i't}$. Then, update $\vec{m}_t^{(j)} = a\hat{\vec{m}}_t + (1-a)\vec{m}_t^{(j-1)}$ where $a \in (0,1)$, as in Krusell and Smith (1998). Since we work with RK4, we can solve the values only at the nodes with even number. Therefore, obtain the values at the nodes with odd number by interpolation.
   (b) Given $(\vec{m}_t^{(j)}, \vec{p}_t^{(j-1)})$, solve for new series $\hat{\vec{v}}_t$ by applying backward shooting to (5) and (13). Update $\vec{v}_t^{(j)} = a\hat{\vec{v}}_t + (1-a)\vec{v}_t^{(j-1)}$ where $a \in (0,1)$. Obtain the values at the nodes with odd number by interpolation.
   (c) Given $(\vec{m}_t^{(j)}, \vec{v}_t^{(j)})$, update $\vec{p}_t^{(j)}$ by solving the clearing conditions (18), (31) , and (35). Since we can solve the clearing conditions at every node, we don't need interpolation. Note that foreign price is obtained by $\tilde{p}_{1t} = p_{1t}/(1+\tau)$ and $\tilde{p}_{2t} = p_{2t}(1+\tilde{\tau})$.
      i. If the distance between $(\vec{m}_t^{(j-1)}, \vec{v}_t^{(j-1)})$ and $(\vec{m}_t^{(j)}, \vec{v}_t^{(j)})$ is large, it is inefficient to solve the clearing conditions simultaneously, in terms of both computation time and the stability of solution. Then, we solve and update each of them separately. Given $(\vec{m}_t^{(j)}, \vec{v}_t^{(j)}, \tilde{\gamma}_{1t}^{(j-1)}, p_{1t}^{(j-1)}, p_{2t}^{(j-1)})$, obtain $\hat{\gamma}_t$ by solving the clearing condition in the capital market of home country. Update $\gamma_t^{(j)} = a\hat{\gamma}_{1t} + (1-a)\gamma_{1t}^{(j-1)}$ where $a \in (0,1)$. Repeat the same procedure for $\tilde{\gamma}_t$, p_{1t}, and p_{2t}.
      ii. If the distance is small enough, given $(\vec{m}_t^{(j)}, \vec{v}_t^{(j)})$, obtain $\hat{\vec{p}}_t$ by solving the clearing conditions simultaneously by the Newton-Raphson method. Update $\vec{p}_t^{(j)} = a\hat{\vec{p}}_t + (1-a)\vec{p}_t^{(j-1)}$ where $a \in (0,1)$.
4. If the distance between $(\vec{m}_t^{(j-1)}, \vec{v}_t^{(j-1)}, \vec{p}_t^{(j-1)})$ and $(\vec{m}_t^{(j)}, \vec{v}_t^{(j)}, \vec{p}_t^{(j)})$ at the predetermined node is sufficiently small, stop calculation and adopt $(\vec{m}_t^{(j)}, \vec{v}_t^{(j)}, \vec{p}_t^{(j)})$ as the solution.

Note that $\vec{m}_0^{(j)}$ and $\vec{v}_T^{(j)}$ are fixed at each jth iteration, since we apply shooting from these points. As long as the steady state and the path from the initial point to it is uniquely defined, $\vec{m}_T^{(j)}$ and $\vec{v}_0^{(j)}$ converge to the true values for a sufficiently large T.

B.4 Numerical Results

Steady State We illustrates here the long-run consequence of trade liberalization by simulating our model under various tariff levels from $\tau = \tilde{\tau} = 0.0$ to 0.12.[19] Throughout the paper, dashed lines are associated with the labor-intensive, solid lines with the capital-intensive, sector. The first, second, and third rows in each figure represent the long-run tendency associated with $\xi = \tilde{\xi} = 1.0$, 0.5 and 0.05, respectively.

[Figure 1] display steady state wages, and welfare under different levels of migration sensitivity. The flat parts of each curve represent the loci of autarky steady state equilibria. In our simulation experiments with $\xi = \tilde{\xi} = 1.0$, 0.5 and 0.05, a trade equilibrium does not exist when the tariff rates are roughly greater than 0.101, 0.099, and 0.074, respectively. As ξ becomes smaller, workers are less sensitive to value differentials across sectors and less likely to switch to the better-paying sector. We demonstrate that under imperfect labor mobility, the welfare implication of Stolper and Samuelson (1941) can be violated, even though the main prediction of the Heckscher-Ohlin framework with respect to specialization and reallocation continues to hold at least qualitatively.

The first row of [Figure 1] shows that the model with imperfect labor mobility is still able to be reconciled with the Stolper and Samuelson (1941)'s doctrine that holds that the value of the abundant resource rises, and the value of the scarce resource falls, with tariff cuts. Indeed, when $\xi = 1.0$, more than 90% of home country workers work in the capital-abundant sector, which is close to the perfect specialization result. Whereas in this case, the welfare consequences depend on a country's endowment, when $\xi = 0.05$ the patterns of workers' lifetime values and wages differ across sectors even within a country. That is, within a given country we may see, under sensitive migration flows, either only winners or only losers, and under insensitive migration flows, both winners and losers.

In our simulation, workers' lifetime value does not vary much across employment status. The dotted lines and dashed-dotted lines in the third and fourth columns represent the lifetime value of the unemployed workers. The curves imply that, given a relatively brief duration, expected lifetime value is not much affected by temporary unemployment. Following Shimer (2005), we calibrate the job finding rate at around 1.35, which means that a typical unemployed worker in the United States receives, on average, 1.35 job offers in each quarter. But in other countries having less efficient labor markets, it may not be the case.

Transition Dynamics [Figure 2] plot the transitory behavior of key variables across different countries and sectors when the tariff level declines from 0.05 to zero. The figures display the transition paths of welfare under different levels of migration

[19] Our numerical experiments suggest that the countries choose an autarky equilibrium rather than a trade equilibrium if the tariff levels are sufficiently high. The flat parts of the curves in [Figure 1] implies that the autarky equilibria are not affected by tariff levels.

sensitivity ξ. Before reform, wages are at the initial steady state level. Immediately after trade reform (at time zero), wages soar in the exporting and drop in the importing sector due to the rapid adjustment of capital, then gradually downward adjust to the steady state level of post-reform in the capital-abundant home, and upward adjust in the labor-abundant foreign, country. Interestingly, wages in the capital-intensive sector 2 jump up at time 0 and then gradually decline in the capital-abundant home country, whereas wages drop and gradually rise in the labor-abundant foreign country. Trade preferences and welfare dynamics after trade liberalization are thus shown to clearly depend on the path of transition.

In [Figure 2], all curves representing lifetime value follow the curves representing wages except when $\xi = 1.0$, in which case the lifetime value of home workers in the exporting sector drops at time zero. This is not surprising in the sense that lifetime value reflects the whole future decline in the wage curve. As in the previous steady state analysis, workers' lifetime value in each sector moves almost together regardless of employment status.

Delayed Implementation [Figure 3] illustrates wage and lifetime value dynamics upon announcement of delayed reform. In the event of sudden implementation, wages in the importing sector immediately drop, but jump in the exporting sector due to the quick adjustment of capital. Wages subsequently decline in the capital-abundant and climb in the labor-abundant country, partially consistent with Stolper and Samuelson (1941). In the event of delayed implementation, wages gradually fall in the capital-abundant, but rise in the labor-abundant, country as the labor force moves from the importing to the exporting sector. As ξ increases, wages, because they reflect the higher reservation based on the higher expected gains from potential migration as well as the marginal product of labor, rise more in the importing sector of the foreign country. The rapid adjustment of capital upon implementation occasions in each sector and each country discrete jumps and drops in marginal product of labor and wages, which subsequently proceed towards long-run equilibrium wages.

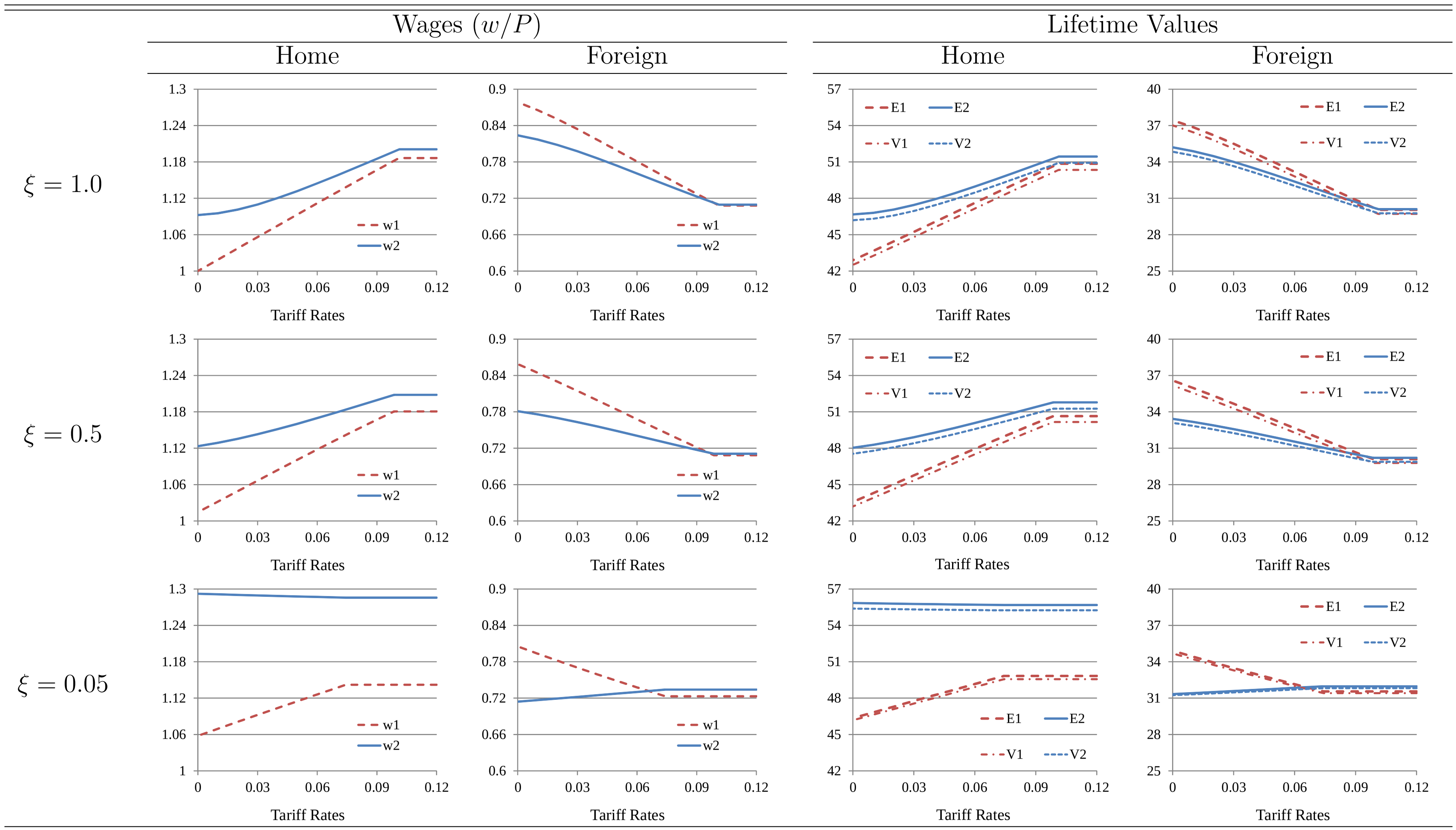

Figure 1: Welfare across Steady States

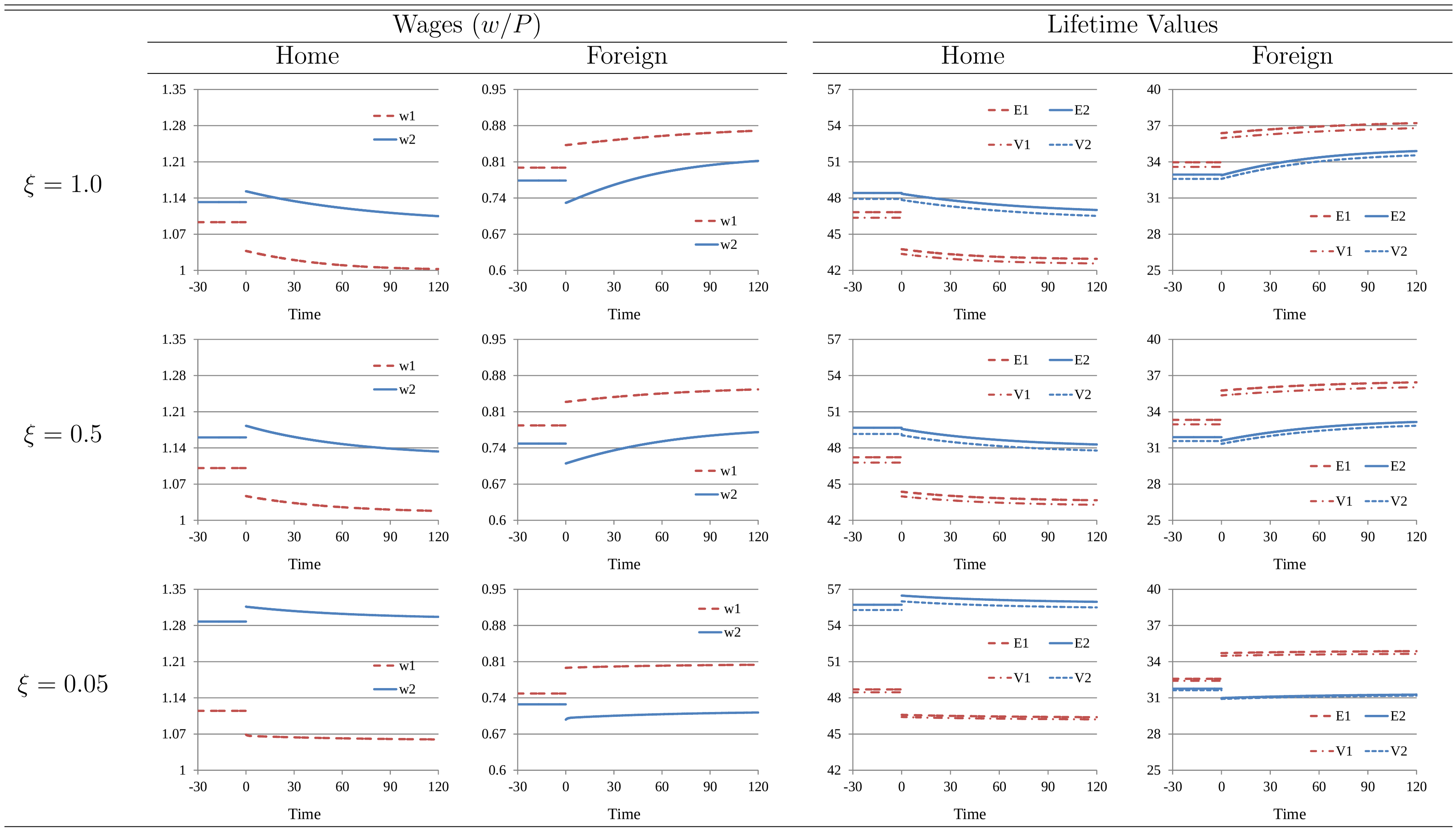

Figure 2: Welfare along the Transition Path

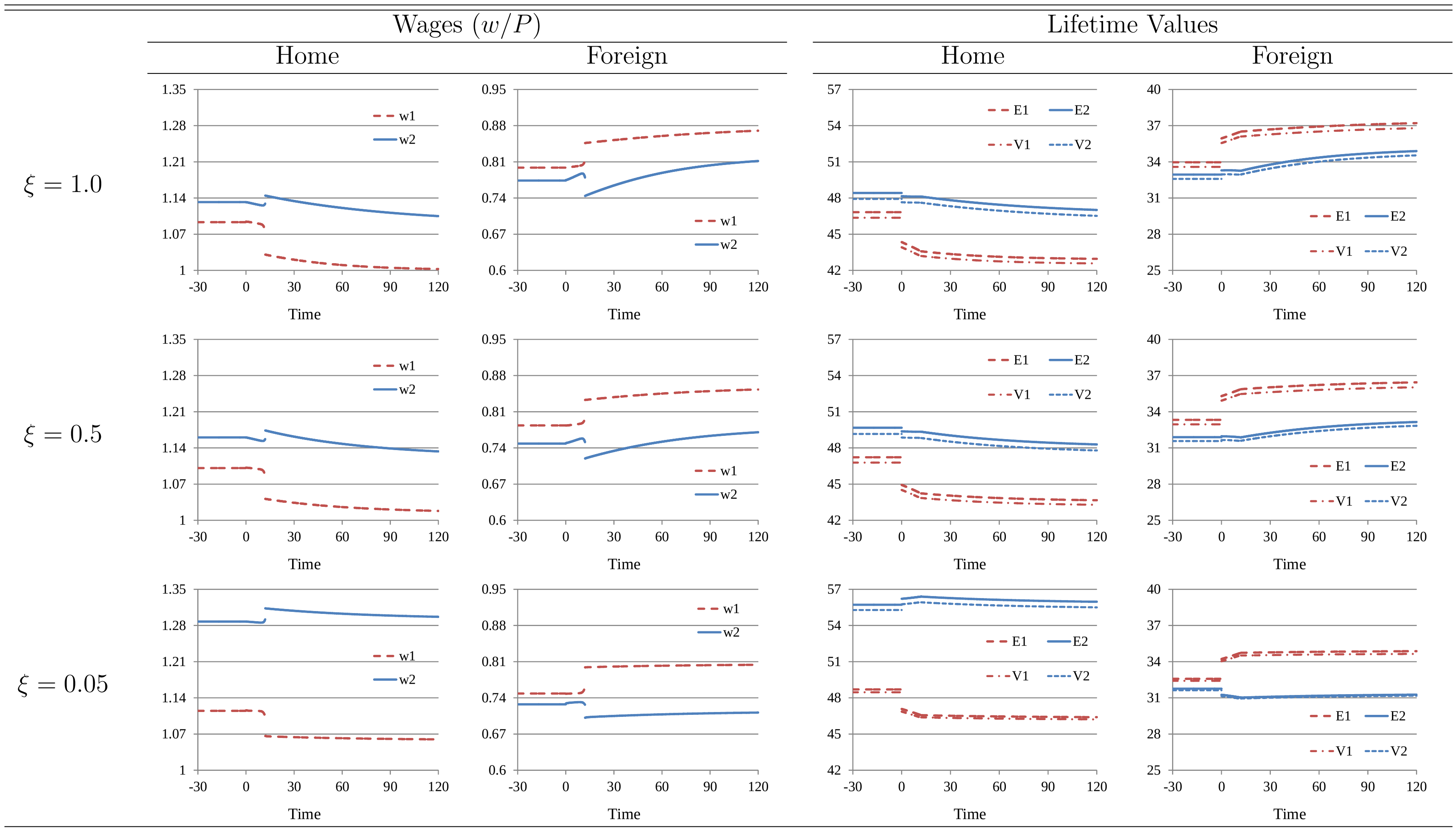

Figure 3: Welfare along the Transition Path Coupled with 3-yr Grace Period