ADJUSTMENT COSTS, TRADE POLICY, AND LABOR MARKET DYNAMICS

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Abstract

We develop a model of the path of wages and employment in an industry before and after a significant reduction in tariffs on industry imports. The model includes forward-looking workers who face significant adjustment costs of moving to another industry. We apply the model to recent data for the U.S. furniture industry in a series of simulations of hypothetical tariff reductions. The model suggests that immediately and unexpectedly eliminating the 6.6% average tariff rate on U.S. furniture imports would reduce domestic employment in the industry by 3.0% in the first two years and by a cumulative 6.3% after five years. Wages would immediately decline by 4.5% and then recover gradually over several years. In contrast, staging the tariff reduction would result in less costly labor adjustment, and wage premia in anticipation of the tariff reduction would partly compensate the workers for upcoming wage losses and adjustment costs. We extend the model to incorporate uncertainty about total expenditure on the domestic and imported products.

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1 Introduction

The past decade has seen a significant expansion in the use of dynamic general equilibrium models of trade with costly labor adjustment to estimate the transition path of wages and employment after a trade shock, following the seminal analysis in Artuç, Chaudhuri and McLaren (2010). Dix-Carneiro (2014) adds worker heterogeneity and accumulation of sector-specific experience to the modeling framework. Caliendo, Dvorkin and Parro (2019) adds inter-industry input-output links and local labor markets. Dix-Carneiro, Pessoa, Reyes-Heroles and Traiberman (2021) adds inter-temporal optimizing trade imbalances.

Dynamic modeling provides a richer analysis of the economic effects of changes in trade policy. By estimating the transition path of wages and employment, dynamic models can capture significant differences between immediate and longer term labor market effects. Dynamic modeling also provides a tool for evaluating the impact of the timing, or staging, of the policy changes.

As an alternative, to the complex dynamic general equilibrium models of trade and labor, we develop a much simpler dynamic partial equilibrium model. The industry-specific model treats the wage available to workers outside of the industry as an exogenous variable. Partial equilibrium models are useful for analyzing a targeted, industry-specific change in trade policy when the industry accounts for a relatively small share of the overall economy.[1] Our model highlights economic factors that shape the adjustment of industry employment and wages before and after a tariff reduction, without adopting the general equilibrium complexity in the literature cited above. Our model focuses on labor losses in the industry with the tariff reduction. It does not attempt to quantify the benefits to consumers or downstream industries from the tariff reduction, to estimate efficiency gains, or to draw conclusions about general welfare.

[1] Partial equilibrium models focus on a more narrowly defined industry rather than the aggregated sectors in economy-wide models, and they have fewer data requirements.

Because workers in our model are forward-looking and face adjustment costs of moving to another industry, labor transitions after a tariff reduction can be prolonged and costly. Workers with higher adjustment costs are more severely affected by the tariff reduction. If they do not move to another industry, they face wage losses; if they move to mitigate these losses, they face adjustment costs. The magnitude and direction of the short-run changes in industry employment and wages depend on these labor mobility frictions, the degree of substitution between imports and the domestic product, and the timing of the tariff reduction.

The staging of the tariff reduction is an important determinant of labor losses. Announcing the reduction years before it is implemented can mitigate wage losses: temporary premia in industry wages partly compensate workers for upcoming wage losses and adjustment costs. When a tariff reduction is announced but not yet implemented, the value of continuing to work in the industry drops, since future expected wages in the industry decline. However, there is not yet a shift in the industry's labor demand curve, since the tariff reduction has not yet occurred, so the wage rises to create an incentive for workers to stay in the industry until the tariff reduction. The resulting wage premia are compensating differentials that reflect the increased risk of future wage losses and adjustment costs.[2]

We demonstrate how the model works by simulating a hypothetical reduction of tariffs on U.S. furniture imports. The model indicates that immediately and unexpectedly eliminating the 6.6% average tariff rate would reduce industry employment by 3.0% in the first two years and by a cumulative 6.3% after five years. Industry wages would immediately decline by 4.5% and then gradually recover over several years. In contrast, a staged tariff reduction would result in less costly adjustment. The model indicates that a staged reduction in period 3 would increase wages by 2.2% before the policy change is implemented.

[2]The model in Artuç et al. (2010) also implies anticipatory wage premia, and Hakobyan and McLaren (2016) provides empirical support for this effect. They find that staged NAFTA tariff reductions resulted in anticipatory wage premia.

An additional advantage of the simpler partial equilibrium framework is that we can add new structural features without running into computational constraints.[3] To illustrate this point, we present an extension that adds uncertainty about total expenditure on the domestic and imported products of the industry. Simulations with the extended model indicate that a mean-preserving spread in future total expenditure increases the wage premia when there is staging and magnifies net labor losses due to the tariff reduction.

The rest of this paper is organized into four parts. Section 2 presents the modeling framework. Section 3 applies the model to recent data for the U.S. furniture manufacturing industry. Section 4 discusses the extension with additional uncertainty, and Section 5 concludes.

2 Modeling Framework

The model has T discrete time periods. There is a permanent tariff reduction that is announced at the beginning of period 1. The implementation of this policy change can be delayed until period 2 or beyond by staging the tariff reduction.

Consumers have CES preferences for the products of the industry. Equation (1) is the value of expenditures on the domestic product in period t.

$$v_t = Y_t \; \frac{(p_t)^{1\,-\,\sigma}}{(p_t)^{1\,-\,\sigma} \;+\; \gamma\;(p_t^*\;(1\;+\;\tau_t))^{1\,-\,\sigma}} \tag{1}$$

Y_t is total expenditure on the domestic and imported products of the industry in period t, p_t is the price of the domestic product, p_t^* is the producer price of imports, τ_t is the tariff rate on these imports, σ is the industry's elasticity of substitution between imports and domestic products, and γ is a preference weight on imports.[4]

[3] Caliendo et al. (2019) notes that their model could be extended to include uncertainty, but they would face significant computational constraints.

[4] The model implicitly assumes that the elasticity of substitution between industry or sectoral aggregates

The domestic industry has a Cobb-Douglas production function with labor cost share α.

$$\alpha = \frac{w_t \; L_t}{v_t} \tag{2}$$

w_t and L_t are the industry wage and employment level in period t. All workers have the same productivity and receive the same wage when employed in the industry. Non-labor inputs, including intermediate goods, are hired competitively from the broader economy at exogenous factor price r_t. There is perfect competition in the domestic industry, and this implies that price is equal to the marginal cost of production.

$$p_t = (w_t)^{\alpha} \; (r_t)^{1 \, - \, \alpha} \tag{3}$$

Each worker has an idiosyncratic, one-time cost of moving to another industry. (In contrast, the general equilibrium literature that follows Artuç et al. (2010) assumes that workers have random and idiosyncratic preference shocks associated with working in each industry, and they assume that adjustment costs are deterministic, identical for all workers, and time-invariant.) In each period t, a worker in our model receives a new draw of adjustment cost c_t from a probability distribution bounded from above by C. We assume that c_t is independent over time and across individuals and is uniformly distributed between zero and C. A worker's expected adjustment cost each period is equal to $\frac{C}{2}$. This adjustment cost could reflect lost wages while searching for the new job, temporary reductions in earning power when starting in a new industry, and costs of moving or retraining.

Workers in the industry are forward-looking and risk-neutral. Their decisions about whether to move to another industry depend on the current and expected future values of their adjustment costs, wages inside of the industry, and wages in the rest of the economy. A worker moves to another industry if the expected present discounted value of moving

is equal to one.

is greater than the expected presented discounted value of staying. The values of these alternatives change over the T periods, and the worker's decision-making has the form of an optimal stopping problem with $T + 1$ options: the worker can exit the industry in one of the T periods or not exit. Since workers face adjustment costs that vary over time, they make a new decision about moving each period that they remain in the industry. Each period there is a probability χ that a worker in the industry will leave the labor force rather than remaining in their job or moving to another industry. This exogenous attrition rate is reflected in the worker's discount factor below.

If a worker has not already moved before period t, there is a cut-off value $\tilde{c}_t$ such that the worker will exit in period t if $c_t < \tilde{c}_t$.

$$\tilde{c}_t = \min \left[\max \ \left[0, \ w_t^* \ - \ w_t \ + \ \beta \ \left(V_{t+1}^* \ - \ \mathbb{E}_t \ V_{t+1}\right)\right], \ C \ \right] \tag{4}$$

w_t^* is the exogenous wage available to the worker in the rest of the economy. The worker's per-period discount factor β is equal to one over one plus the interest rate. V_{t+1}^* is the worker's continuation value outside of the industry, assuming that the worker will not return to the downsizing industry after exiting.[5]

$$V_{t+1}^* = w_{t+1}^* \ + \ \beta \ V_{t+2}^* \tag{5}$$

V_{t+1} is the worker's expected continuation value of staying in the industry in period $t + 1$

$$\mathbb{E}_t \ V_{t+1} = w_{t+1} \ + \ \beta \ \left(1 \ - \ \frac{\tilde{c}_{t+1}}{C}\right) \ V_{t+2} + \ \beta \ \left(\frac{\tilde{c}_{t+1}}{C}\right) \ \left(V_{t+2}^* \ - \ \frac{\tilde{c}_{t+1}}{2}\right) \tag{6}$$

The supply of workers in the industry adjusts as workers move to other industries or new workers enter the industry. A worker with adjustment cost below $\tilde{c}_t$ exits the industry in

[5] Workers will not return after exiting if they do not have industry-specific skills and there are enough potential entrants with low adjustment costs to bound industry wages from above.

period t, so the fraction of industry workers who choose to exit in period t is equal to $\frac{\tilde{c}_t}{C}$. Focusing on a downsizing industry, L_t^s is the supply of workers that remain in the industry in period t when there is no new workers entering.

$$L_t^s = L_{t-1} \; - \; \chi \; L_{t-1} \; - \; (1 \; - \; \chi) \; L_{t-1} \left(\frac{\tilde{c}_t}{C} \right) \tag{7}$$

$\chi \; L_{t-1}$ is exogenous attrition, and $(1 \; - \; \chi) \; L_{t-1} \; \left(\frac{\tilde{c}_t}{C}\right)$ is the number of endogenous exits. L_t^s is less than the equilibrium employment level in period t if new workers are also entering the industry, as we explain below.

We assume that there is a relatively large supply of workers in the rest of the economy that face no, or very low, adjustment costs and will enter the industry each period if the wage is high enough. The possibility of new workers entering the industry bounds w_t from above:

$$w_t \; + \; \beta \; V_{t+1} \leq w_t^* \; + \; \beta \; V_{t+1}^* \tag{8}$$

The expected present discounted value of labor earnings is not greater in the industry than in the rest of the economy when there is a large supply of potential entrants with low adjustment costs. On the other hand, if there is not any new entry and industry employment is set by L_t^s in equation (7), then the industry wage is implicitly defined by the inverse labor demand curve in equation (9)

$$w_t^s = \left(\frac{\alpha \; Y_t}{L_t^s} \right) \; \left(\frac{((w_t^s)^\alpha \; (r_t)^{1 \; - \; \alpha})^{1 \; - \; \sigma}}{((w_t^s)^\alpha \; (r_t)^{1 \; - \; \alpha})^{1 \; - \; \sigma} \; + \; \gamma \; (p_t^* \; (1 \; + \; \tau_t))^{1 \; - \; \sigma}} \right) \tag{9}$$

Equation (10) is the resulting equilibrium wage in the industry in period t, Either the wage is set by new workers entering the industry, or it clears the supply of incumbent workers when there are no new workers entering the industry.

$$w_t = \min \left[w_t^* + \beta \left(V_{t+1}^* \; - \; V_{t+1} \right) , \; w_t^s \right] \tag{10}$$

Equation (11) is the equilibrium employment in the domestic industry at equilibrium wage w_t.

$$L_t = \left(\frac{\alpha\ Y_t}{w_t}\right)\ \left(\frac{((w_t)^{\alpha}\ (r_t)^{1\ -\ \alpha})^{1\ -\ \sigma}}{((w_t)^{\alpha}\ (r_t)^{1\ -\ \alpha})^{1\ -\ \sigma}\ +\ \gamma\ (p_t^*\ (1\ +\ \tau_t))^{1\ -\ \sigma}}\right) \tag{11}$$

L_t is equal to L_t^s plus any new workers that enter the industry in period t.

To summarize, the level of employment in the domestic industry falls gradually after a tariff reduction due to the labor adjustment costs. At first, only the fraction of workers with adjustment costs below the cut-off level exit the industry. In each subsequent period, the workers that remain face new adjustment costs and have new cut-off levels, and a fraction of these remaining workers exit. This continues until the industry reaches its new steady state employment level.

Individual workers face different adjustment costs each period, and these repeated random draws create dynamics.[6] They determine the transition path of industry employment. There is an option value of staying in the industry rather than exiting each period, because an individual's adjustment cost might be lower in later periods. In contrast, if each worker received a single draw in period 0 and adjustment costs remained constant after that, then there would be abrupt adjustments in industry employment when the policy change is announced and then when the tariff reduction is implemented, rather than the smoother and more prolonged transition paths predicted by our model.

After the tariff reduction, the industry wage immediately falls below w_t^*. It returns to w_t^* over time as workers exit the industry. If there is some exogenous attrition, then there is eventual entry of new workers as replacements, and in the new steady state new workers enter at the rate of exogenous attrition.

In addition to the gradual adjustment of industry employment *after* the tariff reduction, there are interesting wage and employment effects *before* the tariff reduction. Since workers

[6]The model will generate a dynamic adjustment process as long as there is some variation over time, even if an individual's adjustment cost are partly uncorrelated over time.

are forward-looking, if the tariff reduction is announced at the beginning of period 1 but implemented with a predictable delay according to an announced staging schedule, then there is a premium in industry wages in the periods between the announcement and implementation ($w_t > w_t^*$ in interim year t) that at least partly offsets expected future wage losses and adjustment costs from the tariff reduction.

Our measure of the expected net losses of a worker in the industry due to the tariff reduction is the change in the worker's expected present discounted dollar value of labor income over the T periods net of the worker's expected adjustment cost. This measure combines three distinct effects: expected wage losses after the tariff reduction WL, expected wage premia after the announcement of the tariff reduction but before it is implemented WP, and expected adjustment costs AC.

$$\textit{Expected Net Loss} \ = WL \ - \ WP \ + \ AC \tag{12}$$

In periods when $w_t < w_t^*$,

$$WL = \sum_{t=1}^{T} \beta^{\,t} \prod_{s=1}^{t} \left(1 \ - \ \frac{\tilde{c}_s}{C}\right) \ (w_t^* \ - \ w_t) > 0 \tag{13}$$

In periods when $w_t > w_t^*$,

$$WP = \sum_{t=1}^{T} \beta^{\,t} \prod_{s=1}^{t} \left(1 \ - \ \frac{\tilde{c}_s}{C}\right) \ (w_t \ - \ w_t^*) > 0 \tag{14}$$

In all of the periods,

$$AC = \sum_{t=1}^{T} \beta^{\,t} \prod_{s=1}^{t-1} \left(1 \ - \ \frac{\tilde{c}_s}{C}\right) \ \left(\frac{\tilde{c}_t}{C}\right) \ \left(\frac{\tilde{c}_t}{2}\right) > 0 \tag{15}$$

Workers who move to mitigate their expected net labor loss. Workers who never move face the maximum net labor loss.

$$Maximum\ Net\ Loss\ = \sum_{t=1}^{T} \beta^{\ t}\ (w_t^* \ - \ w_t) \leq \ Expected\ Net\ Loss \tag{16}$$

3 Application to the U.S. Furniture Industry

In this section, we demonstrate how the model works by simulating a hypothetical tariff reduction in the U.S. furniture manufacturing industry (NAICS code 337).

3.1 Data Sources and Calibration

Table 1 reports key industry data and modeling assumptions. We calibrate the initial period of the model to 2019 annual data for the U.S. furniture industry. Data on the value of shipments, employment, and wages of the domestic industry are from the Annual Survey of Manufactures.[7] Data on the values of imports and exports and the tariff rate are from the USITC's Trade Dataweb.[8]

Table 1: Parameters and Data for the Model

Variables and Parameters	Value
Initial Industry Employment L_0	338,468
Initial Wage w_0	44,389
Initial Value of Imports	48,977,122,209
Initial Value of Domestic Shipments	70,846,866,512
Elasticity of Substitution σ	4.3
Interest Rate for Discounting	0.05
Median Adjustment Costs	88,777
Initial Tariff Rate τ_0	0.0656

In the benchmark simulations below, the estimate of the elasticity of substitution between imports and domestic products in the furniture industry is based on the trade cost

[7] The data are available at `https://census.gov/programs-surveys/asm/data.tables.html`.

[8] The data are available at `https://usitc.gov/data/`. Imports are measured in landed-duty paid value. Exports are measured in free alongside ship value.

econometric approach in Riker (2020). The upper bound on adjustment costs is set equal to four times the annual wage. This implies that the median value is twice the annual wage. This is in line with the estimates in Dix-Carneiro (2014). The price of non-labor factor inputs r_t and the producer price of imports p_t^* are held constant over time and are normalized to one, while the outside wage w_t^* is held constant over time and is set equal to the initial industry wage w_0.

3.2 Benchmark Simulations

The simulations are based on a ten-period version of the dynamic model in Section 2. Table 2 reports benchmark estimates for alternative staging schedules. Each column reports simulated levels of industry wages and employment in the first four periods after the tariff reduction is announced at the beginning of period 1. Each group of rows in the table reports a separate simulation that adopts an alternative assumption about the timing or staging of the tariff reduction. In each of these simulations, the interest rate is 0.05, the elasticity of substitution is 4.3, the upper bound on adjustment costs is 4 w_0, and the expected value of adjustment costs is 2 w_0.

Industry wages generally rise before the tariff reduction, fall in the period of the tariff reduction, and then recover gradually over time. Industry employment falls a little before tariff reductions that are staged (as wages rise in anticipation), falls more in the period of the tariff reduction, and then continues to decline.

Table 3 reports the difference between a worker's expected net loss for each of the alternative staging schedules relative to a scenario with no liberalization in the industry.[9] The table decomposes this expected net change loss into wage losses, wage premia, and adjustment costs over the ten-year time horizon of the model, as discussed in Section 2.

Wage premia occur when there is staging rather than an immediate tariff reduction in

[9]The number is reported on a per-worker basis.

Table 2: Benchmark Simulations

Timing of the Tariff Reduction	Period 0 Outcomes	Period 1 Outcomes	Period 2 Outcomes	Period 3 Outcomes	Period 4 Outcomes
In Period 1					
Annual Wage ($)	44,389	42,409	43,070	43,512	43,806
Employment	338,468	328,172	321,550	317,250	314,444
In Period 2					
Annual Wage ($)	44,389	45,061	42,822	43,346	43,695
Employment	338,468	331,984	324,012	318,855	315,496
In Period 3					
Annual Wage ($)	44,389	44,811	45,341	42,993	43,459
Employment	338,468	334,368	329,344	322,314	317,758
In Period 4					
Annual Wage ($)	44,389	44,653	44,985	45,455	43,061
Employment	338,468	335,891	332,707	328,279	321,639
In Period 5					
Annual Wage ($)	44,389	44,554	44,761	45,054	45,499
Employment	338,468	336,856	334,853	332,047	327,872
No Liberalization					
Annual Wage ($)	44,389	44,389	44,389	44,389	44,389
Employment	338,468	338,468	338,468	338,468	338,468

period 1. All other components of the expected loss are smaller when the implementation of the tariff reduction is delayed by staging. The table also reports the maximum net loss in the model. This is the outcome for workers who do not move to another industry in any of the ten periods.

Table 3: Expected Net Loss Due to the Tariff Reduction

Timing of the Tariff Reduction	Wage Losses ($)	Wage Premia ($)	Adjustment Costs ($)	Expected Net Loss ($)	Maximum Net Loss ($)
In Period 1	5,108.8	0.0	138.7	5,247.5	5,385.5
In Period 2	3,812.7	659.3	113.4	3,266.8	3,379.5
In Period 3	3,218.6	1,299.8	-92.1	2,010.9	2,101.9
In Period 4	2,902.5	1,758.6	77.7	1,221.5	1,298.1
In Period 5	2,695.8	2,036.0	67.9	727.7	794.5

3.3 Sensitivity Analysis

Next, we examine the sensitivity of the simulation estimates to parameter values. Tables 4 and 5 focus on how the magnitude of industry downsizing varies with several of the parameter inputs. All of the simulations in Table 4 assume that the tariff reduction occurs immediately in period 1 and is not staged.

The magnitude of the shift in labor demand is greater when the elasticity of substitution is larger, and this is reflected in more magnified downsizing. Table 5 reports that the wage losses and adjustment costs and the expected net loss are all increasing in the elasticity of substitution.

Lower adjustment costs increase the magnitude of downsizing, since they facilitate exit. On the other hand, easier adjustment also reduces the magnitude of wage losses and expected net loss.

Table 4: Sensitivity of Downsizing After Tariff Elimination in Period 1

Parameter Values	Period 0 Outcomes	Period 1 Outcomes	Period 2 Outcomes	Period 3 Outcomes	Period 4 Outcomes
Benchmark Values					
Annual Wage ($)	44,389	42,409	43,070	43,512	43,806
Employment	338,468	328,172	321,550	317,250	314,444
Increasing σ to 6					
Annual Wage ($)	44,389	41,634	42,501	43,096	43,504
Employment	338,468	323,357	313,510	307,006	302,674
Decreasing C to 2 w_0					
Annual Wage ($)	44,389	42,727	43,461	43,872	44,101
Employment	338,468	324,965	317,745	313,819	311,666

Table 5: Further Sensitivity Analysis

Parameter Values	Wage Losses ($)	Wage Premia ($)	Adjustment Costs ($)	Expected Net Loss ($)
Benchmark Values	5,108.8	0.0	138.7	5,247.5
Increasing σ to 6	7,271.9	0.0	308.0	7,580.0
Decreasing C to 2 w_0	3,342.5	0.0	98.8	3,441.3

The benchmark version of the model assumes that there is no exogenous attrition of the industry's workforce but only exits in response to the tariff reduction. The magnitude of downsizing would be larger if there where exogenous attrition. On the other hand, the wage losses, adjustment costs, and expected net loss would be smaller if there were exogenous attrition. If there were enough exogenous exits to fully accommodate the shift in labor demand resulting from the tariff reduction, then there would be no labor losses at all.

Next, Table 6 illustrates the sensitivity of the magnitude of the wage premium. In all of the simulations in this table, we assume that the tariff reduction is staged: it is announced at the beginning of period 1 but is implemented later in period 3, so there is a wage premium in periods 1 and 2.

If the industry has a larger elasticity of substitution, then there will be more downsizing, as noted above, and also a larger probability of costly adjustment. This increases the magnitude of the compensating wage premia in periods 1 and 2. Lower average adjustment costs reduce the magnitude of the compensating wage premia in period 1 and have no measurable effect on the wage premia in period 2.

Table 6: Sensitivity Analysis of the Wage Premium for Tariff Elimination in Period 3

Parameter Values	Period 0 Outcomes	Period 1 Outcomes	Period 2 Outcomes	Period 3 Outcomes	Period 4 Outcomes
Benchmark Values					
Annual Wage ($)	44,389	44,811	45,341	42,993	43,459
Employment	338,468	334,368	329,344	322,314	317,758
Increasing σ to 6					
Annual Wage ($)	44,389	44,979	45,705	42,429	43,045
Employment	338,468	332,112	324,546	314,306	307,556
Decreasing C to w_0					
Annual Wage ($)	44,389	44,777	45,341	43,218	43,736
Employment	338,468	334,694	329,338	320,101	315,107

4 Adding Demand Uncertainty

The model can accommodate variation over time in the non-policy fundamentals (Y_t, w_t^*, p_t^*, and r_t), though these fundamentals were held constant in the simulations in Section 3. It is also not difficult to include uncertainty about these non-policy fundamentals. To illustrate this point, we consider the effects of uncertainty about total expenditure on the domestic and imported products of the industry on the labor market effects when there is an immediate and unexpected tariff reduction in period 1.[10] We assume that total expenditure will permanently increase from Y_0 to $Y_H = (1 + 0.1) Y_0$ in period 3 with probability ϕ_H, permanently decrease from Y_0 to $Y_L = (1 - 0.1) Y_0$ in period 3 with probability ϕ_L or remain steady at Y_0 with probability $1 - \phi_H - \phi_L$.

Table 7 reports simulations that add upside risk, downside risk, or a mean-preserving spread, along with the corresponding benchmark simulation for reference. A mean-preserving spread in total expenditure increases the wage premium in period 1 relative to the benchmark, leading to a larger decline in industry employment in period 2, but then less cumulative employment reductions starting in period 3, as well as lower wages. Table 8 reports that the expected net loss is reduced relative to the benchmark when there is only upside risk and is magnified relative to the benchmark when there is only downside risk. It is magnified when there is a mean-preserving spread with equal-sized upside and downside risk. The benefits of the upside risk are mitigated by the possibility of new workers entering the industry, while the downside risk is not.

[10] Another possibility would be to model the effects of trade policy uncertainty on labor transitions, drawing on the modeling frameworks in Handley and Limão (2015) and Handley and Limão (2017).

Table 7: Tariff Elimination in Period 2 with Additional Uncertainty

	Period 0 Outcomes	Period 1 Outcomes	Period 2 Outcomes	Period 3 Outcomes	Period 4 Outcomes
Benchmark Case					
($\phi_H = \phi_L = 0.0$)					
Annual Wage ($)	44,389	45,061	42,822	43,346	43,695
Employment	338,468	331,984	324,012	318,855	315,496
Upside Risk					
($\phi_H = 0.2, \phi_L = 0.0$)					
Annual Wage ($)	44,389	45,012	42,721	43,501	43,798
Employment	338,468	332,444	325,019	323,589	320,721
Downside Risk					
($\phi_H = 0.0, \phi_L = 0.2$)					
Annual Wage ($)	44,389	45,161	43,030	43,038	43,488
Employment	338,468	331,035	321,945	315,275	310,988
Mean-Preserving Spread					
($\phi_H = \phi_L = 0.2$)					
Annual Wage ($)	44,389	45,119	42,942	43,172	43,577
Employment	338,468	331,435	322,814	320,204	316,339

Table 8: Average Net Change with Additional Uncertainty

	Wage Losses ($)	Wage Premia ($)	Adjustment Costs ($)	Expected Net Loss ($)
Benchmark Case	3,812.7	659.3	113.4	3,266.8
Upside Risk	3,559.0	612.6	99.6	3,045.9
Downside Risk	4,237.1	755.5	184.8	3,666.3
Mean-Preserving Spread	4,016.5	715.0	173.4	3,474.8

5 Conclusions

The model predicts the transition paths of wages and employment in an industry before and after a reduction in tariffs on industry imports. It quantifies the magnitude of industry downsizing and also the premia in industry wages that can partly compensate workers for future wage losses.

We have demonstrated how the model works by simulating a hypothetical future reduction in tariffs on U.S. furniture imports. The modeling framework could also be applied as a retrospective analysis with slight modification. A retrospective model would estimate the contribution of specific past tariff reductions to past movements in an industry's employment and wages.

As we demonstrated in the extension that incorporates additional uncertainty, it is not difficult to add new structural features to our partial equilibrium framework. This suggests that there is a lot of room for model extensions without running into computational constraints.

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