



A Survey of Empirical Models of Labor Transitions Following Trade Liberalization

Web version:
June 2016

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Abstract

In this article, we survey prominent recent empirical studies that explain why labor markets adjust slowly after a country reduces its barriers to trade. The models that we cover are technically complex: they simulate the economy-wide transitions that result from the employment decisions of individual workers who face costs of moving between sectors, loss of the usefulness of their sector-specific experience, and many types of uncertainty. The adjustment costs in the models vary across types of workers, and the speed of adjustment varies across the countries studied and the modeling assumptions adopted. We present these technical models in a relatively nontechnical way. We summarize the similarities and differences in the assumptions and findings of the different economic studies.

Suggested citation: Riker, David and William Swanson. "A Survey of Empirical Models of Labor Transitions Following Trade Liberalization," *Journal of International Commerce and Economics*. Published electronically May 2016. https://www.usitc.gov/journals/jice_home.htm.

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INTRODUCTION

Trade liberalization can lead to a significant reallocation of workers across sectors of the economy, as exporting sectors expand and import-competing sectors contract. The adjustments in labor markets are not costless. These labor transitions are impeded by the costs to workers of switching sectors, loss of accumulated experience in past jobs, and transitory unemployment during job search. The reallocation of workers is usually not completed for several years, and it is particularly difficult for less educated and older workers.

Concerns about prolonged and costly adjustment of the economy are often at the center of public debate over trade policy. However, they are usually not captured in the economic models used to evaluate trade policies, because the speed and the distributional consequences of the labor market adjustments are very difficult for economists to quantify. Aggregate labor relocation reflects the forward-looking and uncertain employment decisions of a large number of individual workers who can vary significantly in the adjustment costs that they face.

However, in the past few years academic economists have developed structural general equilibrium models that help to bridge this gap.² These models are constructed using economic theory and are fitted to aggregate and micro-level data on the movement of workers across sectors. The models are dynamic: they predict labor market outcomes not only in the short run or in the long run, but all along the transition path following trade liberalization.

The models broadly find that trade liberalization reduces input costs and increases productivity, and that in the long run, both aggregate output and real incomes rise. While there are many workers that start new jobs in exporting sectors, there are also workers that lose jobs in import-competing sectors. Workers move to the expanding sectors, but their skills and training from their old jobs may be less useful. Capital investments may need to be retooled or discarded at a significant cost. This slows the transition of the economy.

In addition to quantifying these adjustment costs and estimating the speed of transition after trade liberalization, many of the models quantify the distributional effects for different types of workers. The latter models are used to evaluate the effectiveness of adjustment assistance to workers.

We organize our discussion of the empirical studies in our survey into two sections. First, we discuss those that first estimate the costs of moving between sectors of the economy, which can include time spent in job search and retraining, and then use these estimates to simulate the speed of labor reallocation after trade liberalization. Second, we discuss those that emphasize the effect of job search frictions on this labor reallocation. Finally, we conclude with a summary of the findings of the empirical studies, and we assess their policy relevance and limitations.

² They build on earlier work, like Wacziarg and Wallack (2004), that also includes econometric analysis of labor transitions after trade liberalizations but is not based on a specific structural model of the economy.

MODELS OF TRADE LIBERALIZATION WITH INTERSECTORAL MOVING COSTS

The first group of models estimates intersectoral moving costs without directly measuring them. The authors then use these moving cost estimates to simulate how the labor markets would adjust to trade liberalization.

Artuç, Chaudhuri, and McLaren (2010)

The seminal paper in this line of research, Artuç, Chaudhuri, and McLaren (2010), models labor adjustments in the United States. The authors use a general equilibrium model with dynamic employment choices to infer the magnitude of moving costs based on intersectoral movement of workers in the data and an arbitrage condition: in every period in their model, each worker decides either to stay in her industry or to move.³ The workers are indifferent on the margin, so the moving costs must reflect current intersectoral wage differentials and potential future wages in other sectors.

Artuç, Chaudhuri, and McLaren estimate intersectoral moving costs using worker-level data from the U.S. Current Population Survey for 1976–2001. Then they simulate the adjustment path of workers across sectors of the U.S. economy in response to hypothetical reductions in the price of traded goods. Their econometric estimates and subsequent simulations of labor market adjustment indicate that the intersectoral reallocation of labor is slow and the movement of wages in response to trade shocks is large. They estimate that intersectoral moving costs in the U.S. economy are more than six times as large as average annual wages.⁴ The authors find, however, that even import-competing workers can benefit from tariff reductions, since they increase the workers' expected future wages. Given the high turnover rates in the model, a worker will likely move to other industries in the future that offer higher wages as a result of the trade liberalization.

Despite the complexity of the dynamic general equilibrium model in Artuç, Chaudhuri, and McLaren (2010), there are several important aspects of labor market adjustments that are not captured in the model. First, there is no unemployment. Workers can move between sectors without engaging in job search. Second, the model relies on a small country modeling assumption that the prices of goods that are internationally traded are set on world markets and do not respond to supply and demand factors in the U.S. market, as if the United States were a very small country relative to the global economy.⁵ The small country assumption simplifies their representation of product markets and allows the authors to focus on labor market transitions,

³ The authors do not specify that factors are included in the moving costs; instead the combined or total moving cost is inferred from the model.

⁴ The authors report their estimates of intersectoral moving costs as a fraction of average annual wages as a benchmark to illustrate the economic significance of the moving costs. For the individual workers that choose to move, the moving cost is greater than the present discounted value of the expected gains.

⁵ Based on this assumption, the prices of traded goods in the model are exogenously determined.

but it also limits the usefulness of the model as a practical tool for evaluating the impact of reductions in U.S. tariffs, because it does not account for the changes in exporters' prices that typically accompany tariff reductions. Finally, the model includes limited worker heterogeneity: it includes only differences between workers based on their age and level of educational attainment. The studies that have followed have built more worker heterogeneity into the models, allowing more elaborate assessments of the distributional effects of the trade liberalizations they model.

Dix-Carneiro (2014)

Dix-Carneiro (2014) builds on the modeling framework in Artuç, Chaudhuri, and McLaren (2010). His dynamic general equilibrium model includes a more extensive treatment of worker heterogeneity: workers vary in their level of education, the amount of sector-specific work experience (or human capital) that they have accumulated, and their age. In every period of the model, forward-looking workers choose a sector of employment or chose not to be employed in the formal sectors of the economy.⁶ Movements between sectors are impeded by costs and also by the loss of the usefulness of their sector-specific experience. The workers' skill levels, proxied by their levels of educational attainment, are characteristics that shape their employment choices and determine aggregate labor market dynamics.⁷ Dix-Carneiro uses the model to estimate trade-induced adjustments in Brazilian labor markets.

Dix-Carneiro uses a panel of matched employer-employee data from Brazil for the period 1995–2005 to estimate the magnitude of intersectoral moving costs. He estimates that the costs are 1.4 to 2.7 times as large as average annual wages, far below the range in Artuç, Chaudhuri, and McLaren (2010).⁸ In addition, because his model includes more worker heterogeneity, Dix-Carneiro finds great dispersion in the magnitudes of these costs across the Brazilian population.

He uses the model to simulate the labor market transition following a hypothetical reduction in the price of internationally traded high-tech manufactured goods, again adopting the simplifying small country assumption that the prices of the traded goods are exogenous in the model. He estimates that the labor market transitions generally last for nine years and can be much longer if there is imperfect capital mobility across sectors. The delay in intersectoral reallocations reduces the aggregate welfare gains from the trade liberalization: he estimates that the adjustment costs offset 11 to 26 percent of the potential welfare gains. The impact on each worker depends on the worker's sector of employment, education, and age. He finds that intersectoral moving costs are higher for female, less educated, and older workers.

⁶ With the inclusion of an informal sector, or home production, trade reforms can affect aggregate employment levels, but the model still does not include involuntary unemployment or job search.

⁷ Danziger (2014) is a related study that models labor market transitions in response to trade liberalization but also endogenizes educational choices.

⁸ Dix-Carneiro explains that his inclusion of sector-specific human capital accumulation accounts for much of the gap between his estimates of the magnitude of intersectoral moving costs and the estimates in Artuç, Chaudhuri, and McLaren (2010).

Dix-Carneiro also discusses several policy implications of his model. For example, he demonstrates that subsidizing moving costs creates an incentive for workers to leave contracting sectors of the economy and move to expanding sectors, and for that reason it is more effective than a retraining program that compensates displaced workers without incentivizing workers to move to the expanding sectors.

Ashournia (2014)

Using a similar model for the Danish labor market, Ashournia (2014) examines adjustment in response to a globalization shock to the country's manufacturing sector. His model focuses on how the dynamic employment choices of workers are affected by the Danish system of unemployment insurance benefits. Ashournia uses matched worker-firm data for Denmark for 1996–2008 and a simulated minimum distance technique to estimate the parameters of his model.

He estimates that the costs of moving between sectors are 1.2 to 2.4 times as large as average annual wages, close to the estimates in Dix-Carneiro (2014). Also like Dix-Carneiro, he estimates that switching costs are higher for female, less educated, and older workers. He finds that only half of the long-run reallocation of labor occurs within the first seven years. Adjustment is slow because workers accumulate sector-specific human capital that is not transferrable, it takes time to gain experience and become productive in the new sector, and there are costs of moving between sectors. All of these factors postpone reallocations in the Danish economy. Ashournia concludes that while unemployment insurance benefits can ease the pain of labor market adjustments after trade liberalization, they also significantly impede the reallocation of resources in the economy.

Artuç, Lederman, and Porto (2015)

Artuç, Lederman, and Porto (2015) use the analytical framework in Artuç, Chaudhuri, and McLaren (2010) to estimate intersectoral moving costs of workers in a large set of developed and developing countries. There they use these estimates to simulate the response of labor markets to trade policy and the welfare implications of slow transitions. They develop a model of forward-looking sectoral employment choices that includes several simplifications from Artuç, Chaudhuri, and McLaren (2010), allowing them to address the data limitations they face as they expand their analysis to the much broader set of countries. They modify the model so that it requires only aggregate data, rather than micro-level panel data, to estimate intersectoral moving costs. Specifically, they assume that workers have perfect foresight (an assumption that the workers perfectly anticipate the economic conditions that they will face in the future) instead of rational expectations (a less restrictive assumption that the workers know the probability distributions for future economic conditions but do not know the actual outcomes in advance). They also assume that the workers do not vary in their levels of educational attainment and accumulated sector-specific experience.

Using 1986–2007 data from the United Nations Industrial Development Organization's Industrial Statistics Database, Artuç, Lederman, and Porto estimate moving costs by matching changes in observed sectoral employment allocations to the predicted allocations from their

model using a minimum distance estimator. Artuç, Lederman, and Porto estimate that moving costs are 3.71 times as large as average annual wages in the developed countries and 2.76 times as large as average annual wages in the developing countries.⁹ Their estimate for the United States is 2.21 times as large as average annual wages, one of the lowest of the countries that they model. This is consistent with the general view that the United States has relatively flexible labor markets. Their simulations of hypothetical declines in world prices of food and textiles indicate that the resulting labor reallocation would take more than six years in many of the countries, but only two years in the United States.

Artuç, Bet, Brambilla, and Porto (2014)

The final study in this group is Artuç, Bet, Brambilla, and Porto (2014). The authors extend their dynamic general equilibrium models by including capital adjustment costs, firm heterogeneity, and intersectoral moving costs. The extended model includes firms' forward-looking decisions to accumulate capital and hire workers, as well as workers' forward-looking decisions about labor supply.¹⁰ They calibrate the extended model to plant-level data and household survey data for Argentina. After estimating the magnitude of the capital and labor adjustment costs, they simulate the interaction (or complementarity) between changes in the prices of traded goods and adjustment costs in the domestic labor and capital markets.

Artuç, Bet, Brambilla, and Porto find that Argentina's adjustment to changes in the prices of traded goods (which they call trade shocks) depends to a large degree on the size of the adjustment costs (which they call domestic distortions). Policies to reduce fixed and sunk costs of capital investment are more effective for facilitating adjustment after liberalization if the trade shocks are small, because there is a "range of inaction" for the firms due to fixed and irreversible costs of investment.

They find that reducing fixed and sunk costs of capital investment yields a benefit that accrues mostly over the short run. Firms will eventually make the changes to the labor force and capital investments anyway, but they will make these decisions sooner if they face lower capital adjustment costs. For these reasons, there is a complementarity between trade reform and domestic distortions that is larger in the short run and for smaller trade shocks. Finally, wages are less volatile when capital adjustment costs are low, because labor and capital mobility smooths out wage spikes.

⁹ These estimates of the magnitude of moving costs are larger than Dix-Carneiro's, in part because Artuç, Lederman, and Porto's model does not account for worker heterogeneity. The relatively large moving costs in developed countries may reflect higher levels of sector-specific human capital in these advanced economies.

¹⁰ In the extended model, they still rely on a small-country assumption, and they do not attempt to model job search.

MODELS OF TRADE LIBERALIZATION WITH LABOR SEARCH FRICTIONS

The second group of models that we survey includes job search frictions that can further slow the economies' adjustment to trade liberalization.

Kambourov (2009)

In the first study in this group, Kambourov examines how institutional features of labor markets affect an economy's transition following trade liberalization. Kambourov builds a dynamic general equilibrium model, which he calibrates to data for Chile and Mexico. His small open economy model includes firing costs, tariffs on imports, and sector-specific human capital that is accumulated on the job. Costs associated with firing workers can slow labor market adjustments. These costs affect decisions about hiring as well as firing, since there is a probability in the model that new hires will become unproductive in the future. Consequently, firms do not fire optimally during a downturn or hire optimally during growth periods. The model includes overlapping generations of workers, and when firing costs are high they can limit labor market reallocations to the rate at which new generations of workers enter the labor force.

Based on simulations of adjustments of the Mexican economy to trade liberalization, Kambourov concludes that Mexico would have experienced a more rapid reallocation of workers across sectors and a larger increase in real output and welfare if it had liberalized its labor markets when it reduced tariffs in the 1980s.¹¹ He concludes that trade policy reforms should be complemented with labor market reforms.

Coşar (2013)

In a second study on the role of job search costs in labor markets' responses to trade liberalization, Coşar (2013) assesses the distributional and efficiency effects of alternative worker-assistance programs in Brazil. His two-sector small open economy model includes overlapping generations of workers, search frictions in labor markets, and sector-specific human capital accumulation. He calibrates the model to aggregate and micro data for Brazil in the 1980s. His model predicts slow reallocation of labor across industries, losses for displaced workers, and a disproportional burden on older workers. In his analysis of adjustment assistance policies, Coşar finds that unemployment insurance can aggravate the short-run adverse effects of the trade liberalization by slowing labor reallocation and skill formation, but that programs that reward work and intersectoral mobility help to speed the transitions. The targeted programs speed transition but also increase net output during the transition.

¹¹ There is some calibration to trade liberalization episodes in Chile and Mexico, but the study does not include an econometric estimation of model parameters.

Pessoa (2014)

Pessoa (2014) develops a dynamic multisector model to quantify the effects on workers and consumers in advanced countries of China's integration into the world economy, given adjustment costs in labor markets. His model of trade includes search frictions and intersectoral moving costs. He finds that the transition is costly for workers in import-competing sectors in the United Kingdom and the United States, who experience lower wages and higher rates of unemployment. However, aggregate welfare increases in both countries. In the United States, the rise in imports from China led to a 1.7 percent decline in real wages in the low-tech manufacturing sector five years after the rise in imports, but a 2.0 percent increase in real wages in the services sector. Using detailed employer-employee panel data for the United Kingdom, Pessoa finds that increased Chinese import competition in an industry reduced the earnings of its employees, increased the length of time that workers were out of a job, and had a greater impact on low-paid, low-productivity workers.

Caliendo, Dvorkin, and Parro (2015)

The final study in this group, Caliendo, Dvorkin, and Parro (2015), uses a dynamic general equilibrium model to quantify the adjustment of employment and the economic welfare of workers over time and across U.S. states in response to the rise in import competition from China. Their model includes job search frictions, heterogeneous firms, and spatially distinct labor markets with varying exposure to domestic and international trade. Unlike the other models that we have surveyed, Caliendo, Dvorkin, and Parro's model includes a detailed treatment of input-output linkages within the U.S. economy.

The authors calibrate the model to 38 countries, 50 U.S. states, and 22 sectors.¹² They use data from the World Input-Output Database and the U.S. Commodity Flow Survey. The estimates in Caliendo, Dvorkin, and Parro (2015) are similar to those in Pessoa (2014), despite differences in the structure of their models. The reduction in real wages in the low-tech manufacturing sector in the United States is slightly lower than Pessoa's. They find that the U.S. economy is better off due to cheaper imported goods, even though exposure to imports from China reduced the share of manufacturing in total U.S. employment by 0.6 percentage points. They estimate that imports from China increased aggregate U.S. economic welfare by 0.2 percent in the short run but by 6.7 percent over the long run. Their model indicates that the magnitudes of the labor market effects are very different across sectors and also across states.

¹² Their data-intensive modeling framework includes 1,150 distinct state-sector labor markets in the United States.

CONCLUSIONS

We have surveyed several of the newest empirical models of labor transitions after trade liberalization. Many are already published in top academic journals, and others are well on their way. These studies provide quantitative estimates for a diverse set of national economies, including Argentina, Brazil, Chile, Denmark, Mexico, and the United States. Most of the studies estimate the magnitude of intersectoral moving costs and also the speed of labor market adjustment following a trade liberalization. The key findings from the empirical studies are summarized in the following table:

Summary of the Main Findings of the Empirical Studies

Author(s) and Year	Main Findings
Artuç, Chaudhuri, and McLaren (2010)	Workers in the United States face very large costs of moving between sectors. Trade liberalization results in slow reallocations and sharp movements in wages, but even workers in import-competing sectors can be better off eventually following the liberalization.
Dix-Carneiro (2014)	Workers' intersectoral moving costs in Brazil are 1.4 to 2.7 times average annual wages. Transitions following trade liberalization can take more than nine years.
Ashournia (2014)	Intersectoral moving costs in Denmark are 1.2 to 2.4 times average annual wages. Switching costs are higher for female, less educated, and older workers. Only half of the reallocation occurs within the first seven years.
Artuç, Lederman, and Porto (2015)	Intersectoral moving costs are 3.71 times annual wages in the developed countries and 2.76 times annual wages in the developing countries. The costs in the United States are 2.21 times annual wages. This is one of the lowest of the countries included in the model.
Artuç, Bet, Brambilla, and Porto (2014)	The adjustment of Argentina's economy to changes in the prices of traded goods depends to a large degree on the size of adjustment costs in the country's labor and capital markets.
Kambourov (2009)	Hiring and firing costs and sector-specific human capital accumulation slows the intersectoral reallocation of labor. Labor market reforms complemented trade reforms in Chile , but lack of labor reforms led to prolonged stagnation after tariff reductions in Mexico .
Coşar (2013)	There is a slow reallocation of labor across industries in Brazil and a large burden on displaced workers and older workers due to job search frictions and sector-specific human capital accumulation. Targeted compensation that encourages intersectoral mobility to new jobs helps the economy to adjust.
Pessoa (2014)	In the United States, the surge in imports from China resulted in a 1.7% decline in real wages in the low-tech manufacturing sector after five years of adjustment, but a 2.0% increase in real wages in the services sector. There is an overall welfare increase in the United States and the United Kingdom . The negative impact is larger on workers who are female, less educated, or older.
Caliendo, Dvorkin, and Parro (2015)	They find that the United States economy is better off due to cheaper imported goods, though exposure to imports from China reduced the share of manufacturing in total U.S. employment by 0.6 percentage points. They estimate that "China's shock increases U.S. welfare by 6.7% in the long-run and by 0.2% in the short-run with very heterogeneous effects across labor markets."

This is a line of economic research that is potentially very relevant to policy makers. The next generation of these models will no doubt build on these studies, adding more structural detail to the models and hopefully using even better data. Even if the specific findings in the table above do not hold in further research, these studies have made important methodological contributions to the economics literature: they develop a set of modeling assumptions that yield complex yet tractable modeling frameworks and methods for estimating the parameters of the model from available data.

There are two main limitations of these models as a tool for evaluating the impact of actual trade policies in countries like the United States. The first limitation is that the trade liberalization scenarios in the studies are in most cases hypothetical. The second limitation is that nearly all of the models adopt a small-country assumption, treating the prices of internationally traded goods as exogenous variables.¹³ The authors adopt the small-country assumption about product markets in order to keep the model tractable while focusing on the complex dynamic decision making in factor markets. However, the prices of traded goods in the United States do respond to conditions in the U.S. market, including dislocation and reallocation in labor markets. These additional general equilibrium effects on the prices of traded goods are part of the impact of trade liberalization that is not yet captured in this line of models.¹⁴

¹³ The models in Pessoa (2014) and Caliendo, Dvorkin, and Parro (2015) focus on the U.S. market and do not impose a small-country assumption, but they model the rise in imports from China. They do not model specific trade policies.

¹⁴ The resulting bias in the estimates of labor market adjustment are ambiguous. They depend on the distribution of the resulting price changes across the sectors of the economy.

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