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# Trade, education, and the shrinking middle class

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ABSTRACT

We develop a new model of trade in which educational institutions drive comparative advantage and the distribution of human capital within and across countries. Our framework exploits a multiplicity of sectors and a continuous support of human capital choices to demonstrate that freer trade can induce crowding out of the middle occupations toward the skill acquisition extremes in one country and simultaneous expansion of middle-income industries in another. Individual gains from trade may be non-monotonic in workers' ability, and middle ability agents can lose the most from trade liberalization. Comparing trade and education policies, our model indicates that targeted education subsidies like Trade Adjustment Assistance are the most effective mechanism to bolster the middle class.



## 1. Introduction

Politicians tend to portray education as a universal panacea for rising income inequality and perceived competition with foreign exporters — a cure-all with which the industrialized world will be able to maintain a thriving middle class and ever-greater standards of living.[1] At the same time, popular sentiment reflects a growing perception that even a solid education no longer guarantees a good job or membership in the middle class.[2] In this paper, we explore a source of the disconnect between political rhetoric and public perception: the reality that workers' responses to globalization and technological change are not uniform. While many workers optimally respond to import competition or routinization by moving up the skill acquisition ladder, others self-select downward into lower skill occupations — the long run consequence of which may be polarization of educational attainment.

We argue in this paper that potential asymmetry in how workers' educational decisions respond to globalization should play a central role in positive and normative evaluations of trade and education policies. To that end, we build one of the first trade models in which human capital responses to globalization may be non-monotonic, with heterogeneous workers acquiring more or fewer skills in response to changes in the wage structure. Our framework highlights how trade and educational institutions interact to determine individuals' skill acquisition decisions and the pattern of comparative advantage across countries. We use this platform to study how education or trade policies can be used to attenuate the 'vanishing middle class' phenomenon recently observed in much of the industrialized world.

Our motivation stems from important recent empirical work that demonstrates three closely related trends: (*i*) the past few decades have witnessed a sharp 'hollowing-out' of middle class, middle-skill employment in a broad set of industrialized countries[3]; (*ii*) trade liberalization and increased import competition are at least partially responsible for some of the middle class job losses and wage decline[4]; and (*iii*) although some workers have responded to increased globalization by increasing human capital investment, others have responded by decreasing educational attainment.[5] Taken together, these three

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[1] e.g. "We [maintain growth] by investing in and reforming education and job training so that all Americans have the skills necessary to compete in the global economy" – President Obama, February 14, 2011 (S679).

[2] The Pew Research Center (2012) found that "85% of self-described middle-class adults say it is more difficult now than it was a decade ago for middle-class people to maintain their standard of living." (*Fewer, poorer, gloomier*) See also Pew Research Center (2014) for evidence that trade is increasingly cited as a cause (*Faith and skepticism about trade, foreign investment*).

[3] Goos and Manning (2007), Autor et al. (2003), Autor et al. (2006), Falvay et al. (2010), Goos et al. (2014).

[4] Hakobyan and McLaren (2010), Autor et al. (2013a, 2013b), Autor et al. (2015).

[5] Edmonds et al. (2009), Hickman and Olney (2011), and Atkin (2012).

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empirical observations suggest that globalization may be inducing polarization in human capital acquisition in concert with the (already well documented) polarization of wages and employment.

This paper proposes a new model to help us understand what might be driving this educational polarization, and which policies might best reverse the trend. Until now the theoretical literature has remained silent on the potential for globalization to induce non-monotonic changes in workers' incentives to acquire human capital. Standard modeling conventions are at least partly to blame. Until very recently, the trade literature has restricted models with endogenous human capital decisions to two-good (and often binary skill choice) settings, which implicitly preclude the possibility of non-monotonic skill change. Customary Stolper–Samuelson forces inherent to two-good models yield a stark theoretical prediction: opening to trade will induce skill upgrading or skill downgrading, but not both. For industrialized countries, these models lead to overly sanguine predictions in which all workers will simply acquire more skills to shift into export-oriented sectors, which in the long run will both increase aggregate human capital levels and mitigate income inequality. By the same logic, these models carry potentially dire predictions for countries with comparative advantage in low-skill sectors.

We find these predictions too simplistic, and so propose instead a flexible many-good, continuous-skill framework that allows us to develop a more nuanced understanding of skill polarization and potential policy responses. Our model features a continuum of heterogeneous agents who differ in their inherent ability to acquire skills through education. Agents choose among a continuum of occupational sectors (or tasks) of increasing complexity, each of which requires a minimum set of skills for employment. Wages are determined by sectoral technology and intermediate good (task) prices — and thus by trade openness — while the cost of human capital acquisition is determined by both individual level characteristics and the country-specific structure of educational institutions and policies. Faced with the resulting incentive structure, agents self-select into occupations by investing in the corresponding human capital, following a tractable assortative matching process based on the complementarity between innate ability and skill acquisition.[6]

We show that comparative advantage can be driven by differences in local educational institutions, which determine the cost of skill acquisition. Trade liberalization leads to a remapping of agents to occupations, as would changes in technology, physical trade costs, or educational institutions. The resulting shift in the demographics of human capital composition can take different forms. One plausible and particularly salient scenario is the hollowing-out of the mid-level occupations toward the higher and lower skill level extremes in one country, and expansion of mid-level occupations in the other.

In a two-country general equilibrium functional form example, we show that skill polarization could be brought about by rising foreign competition in mid-level intermediate goods or tasks, which we trace to differences in the relative convexity of costs of skill acquisition across countries. Intuitively, if ascending to the highest rungs of the educational ladder is relatively more costly in, for example, the less developed country, then the mid-level occupations there will attract disproportionately more and higher ability agents, who will drive down wages in those sectors worldwide. Trade liberalization by the more developed trading partner opens the door to increased competition in mid-skill sectors, inducing polarization in local wages, employment, skill attainment, and individual welfare. More generally, we argue that only in special cases would all agents' human capital decisions respond monotonically to trade liberalization. While the aggregate gains from trade are positive, the distributional consequences are generally complex and non-monotonic.

The model lends itself to policy analysis, and we consider the potential roles for education subsidies and trade policy in shaping the distribution of skills and income. We show that what matters for either policy intervention is not the overall level of education costs or trade taxes, but rather how the policy varies along the occupation/skill dimension. Uniform educational subsidies or trade taxes have no effect in our framework, since they do not influence marginal incentives to acquire skills. When targeted, both education subsidies and tariffs are capable of influencing human capital investment, although these instruments have important differences. Trade policies have distortionary demand-side effects that educational subsidies do not. But more importantly, we argue that political feasibility may be very different for the two instruments. Tariffs to protect middle class jobs are commonplace (Lu et al., 2012), but similarly targeted educational subsidies, which by definition would have to decline for the highest skill levels, are not. Highly targeted education programs like the (now besieged) Trade Adjustment Assistance (TAA) are the most valuable policy tools according to our model, but to be effective in moving displaced workers to higher wage export-oriented sectors, subsidies would have to be large enough to allow workers to reach potentially much higher rungs of the skill acquisition ladder.

Our theoretical approach builds on seminal contributions of Findlay and Kierzkowski (1983), who established the first model of endogenous skill acquisition in a Heckscher–Ohlin setting, and Grossman and Maggi (2000), who first pointed out the importance of the (exogenous) distribution of talent and complementarities between workers in driving comparative advantage. More recently, Jung and Mercenier (2008) propose a model of endogenous human capital decisions in the presence of outsourcing, but key assumptions preclude the possibility for non-monotonic skill responses to trade in their setting, too. Along another dimension, Davidson and Sly (2014) offer a complementary insight, showing that trade liberalization can exacerbate distortionary unproductive (signaling only) education when effort in school is imperfectly observable; we posit that their mechanism could obtain in our setting, too, though our focus is on productive skill attainment. Finally, the model itself incorporates elements from a variety of papers in the trade literature. In modeling occupational output as tradable tasks, we recall Grossman and Rossi-Hansberg (2008). The continuum framework is reminiscent of Dornbusch et al. (1977) and more recently of Yeaple (2005), Ohnsorge and Trefler (2007), Costinot and Vogel (2010), Helpman et al. (2010), and Anderson (2011), who also incorporate heterogeneous agent matching features into a continuum setting which, as here, can generate non-monotonic welfare consequences of trade. None of these models endogenize workers' human capital decisions or study the intersection between trade and education policies, however.

The remainder of the paper is structured as follows. The next section reviews our empirical motivation, tracing a common thread through a series of recent studies at the intersection of the trade and labor literatures. In Section 3, we introduce the model, analyze the effects of trade under a small country setting, and give the equilibrium conditions for the large country case. Section 4 presents a tractable example that delivers a two country general equilibrium case with non-monotonic skill change. In Section 5 we introduce the possibility of education subsidies and tariffs and study their effects. Section 6 concludes.

## 2. Empirical motivation

A series of important papers in the labor literature documents the first empirical regularity cited in the introduction: within a broad set of developed countries, workers have been systematically 'sorting down' — often into low-skill menial jobs — while others simultaneously have been 'sorting up' into higher skill jobs. Goos and Manning (2007) offer a compelling graphical depiction of this employment polarization, reproduced with permission. Based on employment changes in the

[6] This mapping mechanism was used early in the trade context by Grossman and Maggi (2000). See Milgrom and Roberts (1990) for the canonical application in the broader literature. Models with similar supermodularity/complementarity features within the trade literature include, e.g., Antras et al. (2006), Vogel (2007), Nocke and Yeaple (2008), Costinot and Vogel (2010), and Mrazova and Neary (2012).