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Self-employment and trade shock mitigation

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Abstract This paper investigates the moderating effects of entrepreneurial activity on the impact of trade penetration. Entrepreneurs may help to mitigate adverse trade shocks through several mechanisms, i.e., more flexible output structure, diversified economic portfolio, and higher knowledge spillovers from trade-induced R&D activities. Our empirical work embeds the analysis of entrepreneurship, measured using self-employment rates, into a framework of international trade and local labor markets. The empirical results show that the marginal impacts of Chinese import penetration on job losses are dampened in localities with higher self-employment rates, which suggests self-employment or entrepreneurial activities can mitigate the adverse impacts of trade penetration from low-income countries. Our study provides a novel perspective on entrepreneurs' benefits on economic well-being: Besides their direct contribution to economic growth documented in earlier research, they can also enhance the resilience of a local economy in the face of external shocks.

Keywords Self-employment · Entrepreneurship · Trade shocks · Economic resilience

JEL Classifications L26 · R11 · F16 · F61

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1 Introduction

An important phenomenon in international trade during the past several decades has been the rapid rise of newly industrialized countries accompanied by growth in their exports to high-income economies. While economic theory indicates that trade in free markets increases welfare, one of the main debates about the impacts of international trade concerns the distribution of benefits and costs among different regions, sectors, and labor groups (e.g., Bustos 2011; Davis 1998; Krishna et al. 2012; Meckl 2006; Melitz 2003). For developed countries, import competition from low-income economies may impact the labor market more than other trade shocks (Krugman 2008). For US local labor markets, recent studies suggest that increasing exposure to imports from developing countries can result in negative short-run shocks (e.g., Autor et al. 2013; Leichenko and Silva 2004). However, little attention has been paid to the role of localities' idiosyncratic features in shaping their response to import competition. National sub-regions

with higher shares of industries at a comparative trade disadvantage will likely experience short-run labor market losses, while regions more able to adjust their labor markets will better adapt to trade shocks and suffer smaller losses. Therefore, it is possible that regions with certain characteristics suffer less from the same trade shock than others.

Among the factors that may influence a locality's ability to mitigate trade shocks, this paper focuses on entrepreneurship, which we measure using self-employment rates. Self-employment rate is widely used as a proxy for the level of entrepreneurial activities (e.g., Acs et al. 2008; Glaeser and Kerr 2009; Glaeser 2007; Goetz and Shrestha 2009; Rupasingha and Goetz 2013). In this literature, the connection between entrepreneurial activities and economic growth is currently being debated widely. Theories indicate that entrepreneurs can promote economic development by exploiting potential entrepreneurial opportunities or by taking advantage of knowledge spillovers (Acs et al. 2008). The correlation between self-employment and economic growth in US local economies has been confirmed in many recent empirical studies (e.g., Goetz and Rupasingha 2009; Henderson and Weiler 2009; Rupasingha and Goetz 2013; Stephens and Partridge 2011). However, beyond the statistically significant correlations between self-employment and economic development, there is little empirical evidence about *how* self-employment contributes to local economic well-being. Our study provides a new perspective for interpreting the role of self-employment in regional economic growth and development. Given entrepreneurs' characteristics, more entrepreneurial regions may be better able to exploit opportunities, have more diversified economic portfolios, and enjoy greater market vitality. Thus, we hypothesize that in regions with higher self-employment shares, the negative impact of import shocks on the labor market will be smaller.

In this paper, we investigate how the share of the self-employed in the labor force affected the impacts of rising Chinese imports on US counties during 2000–2007. Our empirical approach mainly builds on previous work that investigates the impacts of international trade on local labor markets (Autor et al. 2013; Borjas and Ramey 1995; Chiquiar 2008; Edmonds et al. 2010; Kovak 2013; Topalova 2010). A key approach in these papers is to measure local exposure to trade shocks using a region's industrial employment structure. The regional unit of analysis in this paper is the county, and so we measure import change in a county by weighting each industry's national level import change by the county's employment specialization, as described in more detail in Sect. 3.

For trade data, we focus on the increase in Chinese imports during 2000–2007. As Autor et al. (2013) indicate, first, the increase in Chinese imports made up most of the US import increases from developing countries during this period; second, China's trade advantage was largely due to its increasing productivity and/or lowered trade barriers, which were exogenous to US labor markets, allowing for greater efficiency in estimation. As to the estimation strategy, an important concern is about possible endogeneity of Chinese imports in the local economy. Autor et al. (2013) study the impacts of Chinese import penetration on US commuting zones and address this "endogeneity" issue (without explicit statistical testing) by instrumenting the increase in Chinese imports to the USA with the increase in Chinese imports to other high-income countries. However, Autor et al. (2013) appear to confuse endogeneity at the national level with what may occur at the local level, as it is implausible that a local shock would affect overall Chinese imports to the USA, especially for the local economy as small as a county in our study.[1] A Wu–Hausman test with our county-level data indeed confirms that we cannot reject the "no endogeneity" hypothesis for either metro or non-metro counties.[2] Therefore, we base our empirical work on OLS estimation.[3]

Our empirical results show that as the self-employment rate increased over the period leading up to the recent Great Recession, wage-and-salary job growth declined, but the negative impact of import penetration on job creation was attenuated. Therefore, in those counties with higher shares of self-employed, the detrimental marginal impact of Chinese import penetration on job losses was smaller. The contribution of this paper is twofold. First, for the stream of work on

[1] We are grateful to an anonymous reviewer for pointing this out.

[2] This is shown in the online data appendix.

[3] However, all empirical conclusions in our study are also robust to the 2SLS approach specified by Autor et al. (2013). Regression results are available on request.

the impacts of import competition on local labor markets, our results provide strong evidence that within a country different sub-regions could have varied labor market responses to growing trade exposure, and that local entrepreneurial activity or self-employment helps the locality absorb trade shocks. Second, for the domain of entrepreneurship studies, while most existing empirical studies focus on the direct causal relationship between entrepreneurship level and economic variables such as employment, wage, income, our approach examines whether self-employment can help localities to mitigate negative economic impacts from external shocks. And our findings provide a new perspective for interpreting how entrepreneurs contribute to regional economic well-being, i.e., they may also enhance the resilience of local labor markets.

The remainder of this article is organized as follows. In Sect. 2, we provide a background on entrepreneurship and local labor markets, and discuss possible mechanisms through which self-employment influences local labor market responses to trade shocks. In Sect. 3, we describe our empirical method and data. The estimation results are reported in Sect. 4. Section 5 tests the robustness of the empirical results with alternative model specifications. Section 6 discusses our main findings and concludes the whole paper.

2 Entrepreneurs, local labor markets, and trade shocks

Although the relationship between self-employment and long-term regional development has been examined intensively in the recent literature, few studies consider possible interactions with international trade. This study, to the best of our knowledge, is the first to investigate the role of self-employment in shaping localities' ability to cope with exogenous shocks such as increasing trade penetration. And we suggest that entrepreneurs may reduce the vulnerability of a local economy to trade shocks through the following mechanisms.

First, entrepreneurial activities can help a local economy to more effectively respond to changing market opportunities brought about by trade. Trade liberalization will reveal a country's comparative advantages on a larger market scale and cause fluctuations for local business. Existing market supply–demand systems of regional economies may become imbalanced. For example, when more manufactured products with low-skill content are imported from developing countries at lower prices, the demand for comparable goods produced in the US declines. Meanwhile, when local residents spend less buying these imported merchandises, their demand for high-tech products and non-tradable goods/services that cannot be imported may increase. US regional economies have also been found to adapt to trade shocks mainly through structural adjustments in output (Hanson and Slaughter 2002). In this context of *creative destruction*, entrepreneurship plays an important role (Schumpeter 1934). Entrepreneurial activities that bring about innovations and provide more new products (Acs and Varga 2005; Acs and Szerb 2007) help a region to meet new market demand and rebalance the local economy. Many recent studies also suggest that entrepreneurs play essential roles in an economy's structural change by imposing competition on incumbent firms, creating new business, and absorbing surplus workers from shrinking industries (Fritsch 2013; Gries and Naudé 2010). Thus, we expect that regions with higher shares of entrepreneurs will be able to more effectively rebalance the economy and deal with the adverse shocks of increasing trade exposure, and exhibit better economic performances.

In addition, greater self-employment or entrepreneurial activity is associated with more economic diversity and activity in general within local economies (Eliasson 1991; Silverberg et al. 1988). Such activity may include filling of "market gaps" (Leibenstein 1968) or simple arbitrage (Kirzner 1997), which targets market niches of the local economy, or Schumpeterian innovation, which is aimed at creating new business patterns. As a result, the self-employed may operate businesses that are different from those of dominant incumbent large firms and they increase the diversity of the local economy. Prior studies also show that a diversified economic structure has greater resilience and can better adjust to external shocks due to portfolio effects (e.g., Dissart 2003; Frenken et al. 2007; Kaufmann 1993; Malizia and Ke 1993).

The third mechanism involves two facets—increasing R&D activities that are induced by trade competition, and entrepreneurs' innate capabilities of taking advantage of spillover effects. First, comparative advantage theory indicates that trade liberation will

drive a country to focus more on the products in which it outperforms other countries. Thus, it is reasonable to expect that when facing greater competition from low-income countries like China, developed countries' firms will increase R&D activities and seek to concentrate more on high-tech products or services, which cannot be easily challenged by Chinese competitors. This phenomenon was in fact recently observed. Bloom et al. (2013) find that Chinese import competition significantly increased R&D and patenting activities in European countries during 1996–2007. On the other hand, the role of entrepreneurs in taking advantage of R&D spillovers has been widely discussed recently, and it is believed that entrepreneurs can take advantage of spillovers from incumbent firms' R&D activities and help to more effectively commercialize them (Acs et al. 2008; Braunerhjelm et al. 2009; Qian and Acs 2011). As a consequence, when Chinese import competition stimulates more R&D and patenting activities in a region, if there are also higher levels of entrepreneurial activities in the local economy, the economic outcomes of those R&D and patenting activities are superior, which counteract losses from trade shocks.

To summarize, although the roles of self-employment in helping to mitigate adverse impacts of trade penetration have not been theoretically and systematically analyzed before, we suggest that many aspects of the nature of entrepreneurship can contribute to local economic resilience. In particular, the presence of self-employed or entrepreneurs has been shown to be positively associated with local economic adaptability, diversity, and technology spillovers. In the next section, we design an empirical approach to investigate this moderating effect of entrepreneurial activities in trade-induced losses in local labor markets.

3 Empirical approach and data

3.1 Measure of import exposure

Statistics for import changes at the US regional level such as counties are not available from any open access database. Thus, our measure of counties' trade exposure is indirectly derived based on local industry specialization, an approach widely used in recent studies (Autor et al. 2013; Edmonds et al. 2010; Kandilov 2009; Kovak 2013; Topalova 2010). Specifically, we calculate the following *change in Chinese Import per Worker* (ΔIPW thereafter) to proxy local trade exposure to import competition from China:

$$\Delta \mathrm{IPW}_{\mathrm{US},i} = \frac{1}{L_i} \sum_j \frac{L_{i,j}}{L_{\mathrm{US},j}} \Delta \mathrm{M}_{\mathrm{US},j} \tag{1}$$

In (1), $\Delta \mathrm{M}_{\mathrm{US},j}$ is import change in sector j for the USA during a certain period; $L_{i,j}$ is employment of sector j in county i; $L_{\mathrm{US},j}$ is employment of sector j in the entire USA; and L_i is total employment in county i. Therefore, $\Delta \mathrm{IPW}_{\mathrm{US},i}$ measures the import shock (in thousand $) per worker in county i during the period under study. A greater $\Delta \mathrm{IPW}_{\mathrm{US},i}$ means higher pressure from import competition on the local labor market. The time frame of analysis is 2000–2007, the period after Chinese imports began to prominently increase and before the financial crisis. Thus, the import change $\Delta \mathrm{M}_{\mathrm{US},j}$ is the difference from 2000 to 2007, and $L_{\mathrm{US},j}$, L_i, and $L_{i,j}$ are initial year (2000) values.

3.2 Empirical method and data

We start with a cross-sectional growth model shown in (2) which, as in previous literature, can be used to investigate the impacts of import penetration or other trade policies on local labor markets. Δy_i is a proxy for local labor market performance, such as the change in poverty rate, employment, or wage. Δx_i is the trade-related variable to be investigated, which could be a tariff change or, as in our case, import shock ΔIPW; $\mathrm{cv}_{k,i}$ are other control variables and θ_k their coefficients.

$$\Delta y_i = \beta_0 + \beta_1 \Delta x_i + \sum_k \theta_k \mathrm{cv}_{k,i} + \in_i \tag{2}$$

With a model similar to (2), Kovak (2013) finds that in Brazil those regions where workers faced greater loss of tariff protection experienced more wage cuts. Topalova (2010) investigates the relationship between trade liberalization and poverty in India and indicates that poverty rates fell more slowly in rural regions where production sectors were exposed more to import penetration. Autor et al. (2013) find that commuting zones in the USA that had undergone higher Chinese import exposure had higher unemployment, lower labor force participation, and more wage cuts during

1990–2007, which suggests trade competition from China's imports resulted in negative shocks to US local economies and labor markets. Given these results, we embed self-employment into this trade shock versus local economy paradigm as in (2) and propose that regions with higher self-employment shares can better mitigate the adverse shocks of import competition. Or:

Proposition *In regions with higher shares of entrepreneurs/self-employed, the marginal impacts of Chinese import penetration on job losses are moderated.*

We estimate the following model to test this proposition empirically:

$$\Delta y_i = \beta_0 + \beta_1 \Delta \mathrm{IPW}_{\mathrm{US},i} + \beta_2 \left(\Delta \mathrm{IPW}_{\mathrm{US},i} \times \mathrm{self\_emp}_i\right) + \beta_3 \mathrm{self\_emp}_i + \sum_k \theta_k \mathrm{cv}_{k,i} + \in_i \quad (3)$$

In (3), Δy_i is a proxy for the local labor market performance of a county, for which we use wage-and-salary employment. Although the direct impacts of import competition are mostly on tradable goods or manufacturing sectors, here we are using the employment data for the entire labor market to capture not only the direct impacts of trade shocks but also the multiplier effects and indirect impacts of entrepreneurship on employment (Fritsch and Noseleit 2013a, b). $\Delta \mathrm{IPW}_{\mathrm{US},i}$ is the change in Chinese imports per worker as defined in (1), and $\mathrm{self\_rate}_i$ is the share of self-employment in total employment at the initial year 2000, which is calculated using the US Census data.[4] In this model, the net coefficient of trade penetration $\Delta \mathrm{IPW}_{\mathrm{US},i}$ is $(\beta_1 + \beta_2 \mathrm{self\_emp}_i)$, which should be negative given that trade shocks tend to adversely affect local labor markets in general. However, if the above proposition holds, i.e., self-employment mitigates an import shock's negative impact on the local labor market, then we expect $\beta_2 > 0$, which means in more entrepreneurial regions the net effects of trade shocks are smaller in scale.

To calculate the import shock $\Delta \mathrm{IPW}_{\mathrm{US},i}$ from (1), data of Chinese imports to the US $M_{\mathrm{US},j}$ come from the US Census Bureau's US International Trade Statistics database[5]; data for $L_{i,j}$, $L_{\mathrm{US},j}$, and L_i for different periods are from the US Census Bureau's County Business Patterns (CBP). For the local economic performance proxy Δy_i in model (3), we use log change of employment (wage-and-salary job) during 2000–2007, which is from the Bureau of Economic Analysis (BEA).[6] For calculating the ratio of self-employment in total employment, the data of self-employment and total employment come from the US Census 2000 database.[7] We also include some other control variables of local demography in model (3). They are the share of college-educated people in total population, the ratio of white people, the age composition of local population, and the number of local population. All of these control variables are initial year (2000) values and are also derived from the US Census 2000 database.

3.3 Industrial structure

Besides the local demographic control variables mentioned above, other important structural variables need to be controlled for given the specification of our model and the trade shock measure. They are the local industrial structure, firm size effects, and the distribution of entrepreneurs between traded and non-traded sectors, which we discuss in the following three subsections.

The industrial structure of local economies must be controlled for in the model due to two concerns. First, self-employment rates vary significantly between different sectors, and these sectors are likely to have different growth rates. If industry shares are not appropriately accounted for, the empirical results may just reflect the impact of industrial composition on local economic growth rather than that of entrepreneurial activities. Second, because we estimate a conventional growth model using cross-sectional data, our results could be affected by differential growth rates arising as fixed effects (such as growth in Detroit persistently lagging behind that in Phoenix).[8] Sector productivity differences are the most important fixed effects that we are concerned with. In our model, the

[4] In the 2000 US Census data, total employment consists of four parts: wage-and-salary employment in private sectors, government employment, self-employment, and unpaid family workers.

[5] http://www.census.gov/foreign-trade/data/.

[6] http://www.bea.gov/regional/index.htm.

[7] http://www.census.gov/main/www/cen2000.html.

[8] We especially thank one of our reviewers for these suggestions.

measure of trade penetration is primarily based on import values, and thus, we would otherwise miss regional productivity growth variations that arise from different industrial structures. In particular, the variations within non-traded sectors are not well represented in the trade penetration measure of Eq. (1). Given these concerns, we also control for lagged regional industrial structure of counties. We calculate the employment shares of the 10 SIC industry divisions in each county for the year 1990 as industrial structure control variables in our model.[9]

3.4 Firm size effects

While self-employment is most commonly used as a proxy for entrepreneur activities in similar studies, it is also strongly correlated with average firm size in the local economy. A higher ratio of self-employed establishments, with only one employer/employee, reduces the average employment size of local firms. On the other hand, previous literature suggests that the firm size of tradable sectors affects the impacts of trade shocks. Bernard and Jensen (1995) point out that large firms more likely engage in international trade. Other researchers who focused on the relationship between firm size and productivity found that smaller firms, which usually have lower productivity, are more likely to be driven out when faced with rising import penetration (Bernard et al. 2003; Melitz 2003). However, Holmes and Stevens (2014) propose an opposite mechanism that smaller firms, which focus their business more on customized goods and services for local markets, are less likely to be impacted by increasing imports of labor-intensive goods from developing countries.

The existing literature thus provides competing implications for the relationship between firm size and the impacts of trade shocks. The purpose of this paper is not to resolve this debate, but we need to control for this possible firm size effect so as to ensure that what our model tests is the role of self-employment in mitigating trade shocks that is due to entrepreneurship rather than firm size. The firm size variable firm_size_i here is measured as the average number of employment per establishment in county i, which is also calculated from the CBP 2000.

3.5 Distribution of self-employment between traded and non-traded sectors

Measuring entrepreneurial activities as the ratio of self-employment in total local employment ignores the distribution of self-employers across different industries, especially for traded and non-traded sectors. Earlier studies about trade liberation also suggest that traded and non-traded sectors play different roles in the presence of import shocks and should be treated differently (see, e.g., Kovak 2013; Topalova 2010). In Sect. 2, we discussed several possible mechanisms that make entrepreneurial regions more resistant to trade shocks, i.e., smoother structural change, a more diversified economic portfolio, and knowledge spillovers. All of these mechanisms function on a sector-basis, and the share of entrepreneurs in traded industries may have a more direct and immediate impact on the local economy in terms of attenuating the effects of trade penetration.

Data limitations do not allow us to examine these ideas directly for the self-employed. However, another data set, the non-employer statistical series (US Census Nonemployer Statistics[10]), which is highly correlated with the self-employment series,[11] does provide industry sector detail, and this allows us to create a tradable versus non-tradable non-employer data series as a self-employment proxy at the county level for 2000. Non-employers are small businesses that have no paid employees and are subject to federal income tax, and are different from and yet similar to self-employers.[12] We create a proxy variable consisting of the share of non-employers in the traded sector

[9] The SIC industry division codes can be found in http://www.naics.com/sic-codes-industry-drilldown/. County employment data of SIC industries are from the CBP data set mentioned above. More descriptive information about the industrial structure control variables is provided in the online data appendix.

[10] https://www.census.gov/econ/nonemployer/index.html.

[11] The covariance between the number of self-employed and non-employers is 0.976 at the county level.

[12] In particular, "most nonemployers are self-employed individuals operating unincorporated businesses (known as sole proprietorships), which may or may not be the owner's principal source of income." For definitions and non-employer data, see https://www.census.gov/econ/nonemployer/index.html.

Table 1 Descriptive statistics for county labor markets (metro and non-metro counties)

Variable	Metro		Non-metro	
	M	SD	*M*	SD
Change in Chinese import per worker ($\Delta IPW_{US,i}$), 2000–2007/(thousand $)	4.38	2.18	4.62	2.85
Log change in the count of W&S employment, 2000–2007/(100 × log points)	7.28	13.70	0.55	12.61
Share of self-employment in total employment, 2000/(%)	6.99	2.28	11.14	5.18
Percentage of college-educated population, 2000/(%)	20.51	9.42	14.40	5.73
Percentage of white people, 2000/(%)	82.64	15.06	85.38	17.26
Percentage of population age 50–59, 2000/(%)	11.42	1.41	11.80	1.57
County population, 2000/(10 thousand)	21.85	47.88	2.38	2.28
Average firm size, 2000/(employment per establishment)	14.09	5.07	11.02	4.43
Share of non-employers in traded sectors, 2000/(%)	1.66	0.84	1.59	1.45

$\Delta IPW_{US,i}$ are calculated by authors with Eq. (1); wage-and-salary employment data are from the BEA; demographic control variables are calculated from the US Census 2000; firm size data are calculated from CBP 2000; non-employer data are from US Census Nonemployer Statistics

among all non-employers in a county and then include it as a control variable into Eq. (3). Table 1 provides descriptive statistics for all of the above variables, except for the industrial structure variables which are shown in the online data appendix.

4 Empirical results

In this section, we estimate the model of Eq. (3) for metro and non-metro counties separately. The dependent variable Δy_i is calculated as the log value in 2007 minus the log value in 2000, so that the regression coefficients provide the percentage change from the initial year. For ease of interpretation, in all regressions of this paper, the share of self-employment $self\_emp_i$ and the import shock $\Delta IPW_{US,i}$ is calculated as deviations from their median values of the regression samples. OLS results of model (3) are shown in Table 2 for metro and non-metro counties, respectively. Both columns include all the control variables listed in Table 1 as well as the lagged industrial structure control variables. And we also include state dummies to control for regional fixed effects.

In Table 2, the coefficients of $\Delta IPW_{US,i}$ are negative and statistically significant in both columns, which means counties with higher import increases from China had less employment growth compared with counties not experiencing such increases. More importantly, the coefficients of cross-term ($\Delta IPW_{US,i} \times self\_emp_i$) are statistically significant and positive for both metro and non-metro counties, which means the net marginal impacts of Chinese import shocks, expressed as ($\beta_1 + \beta_2 self\_emp_i$), are smaller in the regions that have higher shares of entrepreneurs. Thus, these results confirm our earlier proposition that in counties with higher shares of entrepreneurs/self-employment, the adverse impacts of trade shock on local labor market are dampened.

Based on the results of Table 2 and the distribution of self-employment rates over counties, we can retrieve the point estimates of the impacts of trade shocks over the spectrum of self-employment rates. Since in our regressions, the share of self-employment is calculated as the deviation from its median value, the coefficient of $\Delta IPW_{US,i}$ in Table 2 should be interpreted as its actual point estimate for a county with the median self-employment rate. In Table 3, we calculate the marginal impacts of a one thousand dollars change in Chinese imports per worker on labor markets at the 25, 50, and 75 % self-employment rate percentiles for metro and non-metro counties, respectively. We can see that for both metro and non-metro counties, the trade-induced job losses of counties at the 75 % percentile of self-employment rate are much lower than those in counties at the 25 % percentile.[13] It

[13] The geographic unit of analysis in our study is the county, which we suggest can provide more policy implications as in the USA it is the smallest administrative level with a functional government. But our main conclusions are also robust to using commuting zones, which are provided by the ERS/USDA based on labor market coherence. Detailed results are not reported here but are available on request.

Table 2 Cross-effects of self-employment and import shocks in county labor markets (2000–2007). DepVars: 100 × ΔLog (counts of wage-and-salary employment)

	(a) Metro counties	(b) Non-metro counties
Change in Chinese import per worker ($\Delta IPW_{US,i}$)	−0.766***	−0.558***
	(0.176)	(0.140)
Cross-term ($\Delta IPW_{US,i} \times self\_emp_i$)	0.199***	0.085***
	(0.051)	(0.024)
Share of self-employment in total employment ($self\_emp_i$)	−1.016***	−0.199**
	(0.327)	(0.085)
Percentage of college-educated population	0.460***	0.252***
	(0.097)	(0.054)
Percentage of white people	0.222***	0.094**
	(0.078)	(0.035)
Percentage of population age 50–59	−1.210*	−0.281
	(0.664)	(0.249)
Population	−0.001	0.597***
	(0.008)	(0.164)
Ave. firm size	−0.677***	−0.286*
	(0.142)	(0.148)
Share of non-employers in traded sector	1.177*	0.831***
	(0.662)	(0.205)
Lagged industrial structure (1990)	Yes	Yes
State dummies	Yes	Yes

$N = 1051$ for metro counties and $N = 1987$ for non-metro counties. Robust standard errors clustered by state are in parentheses. $\Delta IPW_{US,i}$ and $self\_emp_i$ are calculated as deviations from their median values, respectively (split by metro and non-metro counties, respectively)

Level of statistical significance: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$

Table 3 Marginal impacts of $1000's change in Chinese import per worker on employment growth for counties with different self-employment rates (2000–2007)

	(a) Metro counties Calculated from Table 2(a) (%)	(b) Non-metro counties Calculated from Table 2(b) (%)
At 25 % percentile of self-employment rate	−0.979	−0.747
At 50 % percentile of self-employment rate	−0.766	−0.558
At 75 % percentile of self-employment rate	−0.428	−0.251

Author calculations, based on the results of Table 2. The self-employment rates at the 25, 50, and 75 % percentile are 5.36, 6.43, and 8.13 % in metro counties and are 7.54, 9.76, and 13.37 % in non-metro counties

should be noted that Table 3 describes the mitigating effects of self-employment on trade shocks, rather than the net impacts of self-employment on county employment growth. Given that the coefficients of self-employment in Table 2 are significantly negative, only in cases with sufficiently high exposure to trade shocks will self-employment increase overall employment growth in the period 2000–2007. In future research, it would be important to examine how stable this relationship is over time.

5 Robustness analysis

In model (3), we assume that regions with different self-employment rates experience varied impacts from trade shocks. However, it is possible that not only the

self-employment rate but also other factors influence this trade impact.

Our first concern is the higher-order impacts of import exposure. In model (3), only the linear form of import change per worker $\Delta\text{IPW}_{\text{US},i}$ is included. In addition, we noticed that for counties, the self-employment rate has a weak but significant correlation with the trade penetration.[14] Thus, it is possible that the cross-term of $\Delta\text{IPW}_{\text{US},i} \times \text{self\_emp}_i$ merely picks up the explanatory power of the squared term of $\Delta\text{IPW}_{\text{US},i}$. Another potential problem is that other characteristics of counties may also affect the actual coefficient of import exposure on the local labor market, such as the demographic control variables listed in Table 1. Then, the actual coefficient of $\Delta\text{IPW}_{\text{US},i}$ would be:

$$\beta_{\text{actual}} = \beta_1 + \beta_2 \text{self\_emp}_i + \gamma \Delta\text{IPW}_{\text{US},i} + \sum_k \alpha_k \text{cv}_k$$

Thus, model (3) becomes:

$$\begin{aligned}\Delta y_i = {} & \beta_0 + \beta_{\text{actual}} \Delta\text{IPW}_{\text{US},i} \\ & + \beta_3 \text{self\_emp}_i + \sum_k \theta_k \text{cv}_{k,i} + \in_i \end{aligned} \quad (4)$$

And the testable form of (4) is:

$$\begin{aligned}\Delta y_i = {} & \beta_0 + \beta_1 \Delta\text{IPW}_{\text{US},i} + \beta_2 \left(\Delta\text{IPW}_{\text{US},i} \times \text{self\_emp}_i\right) \\ & + \gamma \Delta\text{IPW}^2_{\text{US},i} + \sum_k a_k (\text{cv}_{k,i} \times \Delta\text{IPW}_{\text{US},i}) \\ & + \beta_3 \text{self\_emp}_i + \sum_k \theta_k \text{cv}_k + \in_i \end{aligned}$$

where the $(\text{cv}_{k,i})$ include all the demographic control variables in Table 1. The regression results of model (5) for metro and non-metro counties are shown in Table 4. After including the squared term of $\Delta\text{IPW}_{\text{US},i}$ and other cross-effects that may influence the model, the cross-effects of self-employment rate and $\Delta\text{IPW}_{\text{US},i}$ remain significantly positive and are of similar magnitude, consistent with results in Table 2.

6 Discussion and concluding remarks

This paper imbeds the analysis of self-employment into a framework of trade shock and local labor market, in order to study the roles of entrepreneurial activities in the resilience of local economy. Our empirical results reveal that there are significantly positive cross-effects of trade penetration and self-employment on local employment growth during 2000–2007, which suggests that self-employment in a county has a significant role in mitigating the negative impacts of import shocks on local labor market. Our empirical results are robust when we control for the lagged industrial structure, the firm size effects, and the distribution of entrepreneurs between traded and non-traded sectors. These findings confirm the benefit of entrepreneurs or the self-employed in promoting local economic development. And our approach provides a new perspective about entrepreneurial activities' indirect impacts on local economy, i.e., self-employment helps a region to mitigate the adverse impacts of external shocks and thus contributes to local economic resilience.

Due to the lack of available self-employment data at the industrial level, we did not distinguish the roles of self-employment in different kinds of sectors such as traded versus non-traded. However, we are able to use non-employer data as a proxy variable to investigate separately the effects of self-employment in the tradable sectors. Once data at finer industrial levels become available, it would be important to examine the potential trade-mitigating impacts of entrepreneurial activities in greater detail. Recent studies confirm that the economic consequences of entrepreneurship are largely sector-based and strongly depend on an industry's life cycle, innovation intensity, and intra-industry competitions (Boschma and Frenken 2011; Fritsch and Noseleit 2013a, b; Fritsch 2011; Low and Isserman 2013). Thus, investigating the roles of self-employment/entrepreneurs in regional economic resilience at disaggregate industrial levels will likely contribute to a deeper understanding of entrepreneurship.

Another future extension is toward a theoretical and systematic framework of entrepreneurship's roles in enhancing regional economic resilience. In this paper, we suggest several possible mechanisms that explain why self-employment can mitigate trade shocks on local labor market, i.e., regions with higher shares of self-employment may have greater flexibility in the output markets and have a more diversified industrial portfolio, and can more effectively exploit knowledge spillovers from incumbent firms' R&D activities stimulated by trade competition. We were unable to

[14] Regression of $\Delta\text{IPW}_{\text{US},i}$ on the self-employment rate yields: coeff = -0.086, $t = -5.3$, $R^2 = 0.04$.

Table 4 Sensitivity analysis of the cross-effects of self-employment and import shocks in county labor markets (2000–2007). DepVars: 100 × ΔLog (counts of wage-and-salary employment)

	Metro counties		Non-metro counties	
	(a)	(b)	(c)	(d)
Change in Chinese imports per worker ($\Delta IPW_{US,i}$)	−0.441	1.808	−0.812***	−3.531***
	(0.318)	(3.130)	(0.197)	(1.303)
Cross-term ($\Delta IPW_{US,i} \times self\_emp_i$)	0.251***	0.287***	0.081***	0.052*
	(0.054)	(0.061)	(0.025)	(0.030)
Share of self-employment in total employment	−0.997***	−0.997***	−0.204**	−0.219**
	(0.318)	(0.315)	(0.084)	(0.084)
$\Delta IPW^2_{US,i}$	−0.036*	−0.033*	0.024*	0.032**
	(0.019)	(0.019)	(0.012)	(0.013)
All cross-terms of ($cv_{k,i} \times \Delta IPW_{US,i}$)		Yes		Yes
Lagged industrial structure (1990)	Yes	Yes	Yes	Yes
State dummies	Yes	Yes	Yes	Yes

$N = 1051$ for metro counties and $N = 1987$ for non-metro counties. All columns include the control variables in Table 1. Robust standard errors clustered by states are in parenthesis

Level of statistical significance: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$

find direct evidence in the literature that these mechanisms have actually been observed systematically, but this may be accomplished by future studies.

Our findings also have important implications for policy makers and local economic development practitioners in coordinating local development strategies and trade-related labor market policies. In the USA, in order to promote local economic prosperity, governments have provided various incentives such as subsidies or tax breaks to support local self-employment (Goetz et al. 2010, 2011). Also, as a result of extensive labor market shocks resulted from increasing imports from developing countries, policies such as the Trade Adjustment Assistant program have been enacted to address trade-related job loss. Our empirical results suggest that local entrepreneurial activities or self-employment can also reduce adverse impacts of trade shocks, and it is advisable to better coordinate these two kinds of policies in order to achieve greater policy efficiency. But it should also be noted that Chinese import penetration in the first decade of 2000s was a special case of external shocks facing local labor markets of developed countries, which mostly involved competition from low-wage manufacturers in particular. Thus, caution should be exercised in generalizing the conclusions of this article to other shocks. We hope future studies can provide more insights into the relationship between entrepreneurship and economic resilience with regard to different forms of external shocks.

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