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Who Creates New Firms When Local Opportunities Arise?

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Abstract

New firm formation is a critical driver of job creation, and an important contributor to the responsiveness of the economy to aggregate shocks. In this paper we examine the characteristics of the individuals who become entrepreneurs when local opportunities arise due to an increase in local demand. We identify local demand shocks by linking fluctuations in global commodity prices to municipality level agricultural endowments in Brazil. We find that the firm creation response is almost entirely driven by young and skilled individuals, as measured by their level of experience, education, and past occupations involving creativity, problem-solving and managerial roles. In contrast, we find no such response within the same municipalities among skilled, yet older individuals, highlighting the importance of lifecycle considerations. These responsive individuals are younger and more skilled than the average entrepreneur in the population. The entrepreneurial response of young individuals is larger in municipalities with better access to finance, and in municipalities with more skilled human capital. These results highlight how the characteristics of the local population can have a significant impact on the entrepreneurial responsiveness of the economy.

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TABLE OF CONTENTS

APPENDIX-TABLE

I. Introduction

Entrepreneurship plays a critical role in aggregate job creation, with new businesses responsible for the majority of new employment in the economy (Decker et al. (2014); Haltiwanger et al. (2013b)). At the same time, entrepreneurship and the creation of new firms is a multi-faceted phenomenon. Some types of entrepreneurship might best be described as Schumpeterian, in which talented individuals create new technologies or products that facilitate a creative destruction process in the economy disrupting existing organizations (Schumpeter (1942)). Other types of entrepreneurship would better be described as Kirznerian, in which alert individuals identify the existence of new and exogenous investment opportunities created by changing market conditions, and take advantage of them by forming new businesses (Kirzner (1973, 1985)).

This latter form of entrepreneurship is increasingly recognized as an important driver of economic dynamics. A growing theoretical and empirical literature shows that new business formation is key to understanding how economies respond to aggregate shocks. For example, a variety of macroeconomic studies have emphasized the role new firm creation plays in the amplification and propagation of exogenous economic shocks (e.g., Bilbiie et al. (2012); Clementi and Palazzo (2016); Sedláček and Sterk (2017)). At the micro level, Adelino et al. (2017) show that new firms are responsible for the majority of jobs created in response to changes in investment opportunities driven by local demand, and Decker et al. (2017) find that new firms account for most of the employment growth in regions that experienced a significant economic expansion due to the discovery of shale oil and gas.

While recognizing the importance of the firm entry response to local economic shocks, little is known about the characteristics of the individual entrepreneurs who identify and act upon such opportunities when they arise. Do such entrepreneurs share similar defining traits with other entrepreneurs in the economy, or do they differ in substantive and meaningful ways? This issue is particularly salient. If these entrepreneurs are concentrated in a particular segment of the population, then characteristics of the local population and long-term demographic trends may have significant implications for the entrepreneurial responsiveness of the economy. Moreover, understanding the key traits of such individuals may be important to policymakers in thinking how to foster vibrant, dynamic local economies. In this paper, we fill this gap and explore the personal and career characteristics of the individuals who create new firms in response to changes in local economic opportunities.

Tackling this question empirically poses two challenges. First, exploring this question requires employer-employee matched data that follow individuals over time and that allow for identifying *when* individuals choose to become entrepreneurs. Second, in order to study the entrepreneurial response of individuals to opportunities, we need a source of plausibly exogenous variation in local economic opportunities. For both these reasons, we choose to study the Brazilian economy.

First, our study relies on administrative employer-employee matched data from the Brazilian Ministry of Labor, which capture all the employees in the formal sector, and include information on their work history, wages, education, gender, and occupation. These data allow us to not only identify the founders of new firms, but also to observe a rich set of information regarding their personal characteristics *before* the creation of the new firm. Second, the large agribusiness sector in the Brazilian economy allows us to identify exogenous local income and demand shocks arising from global commodity price fluctuations, and to study the firm creation response.[1] Specifically, we interact municipality level historical production endowments of agricultural crops with contemporaneous changes in global commodity prices, a strategy similar in nature to Allcott and Keniston (2017) in the context of US oil and gas booms and Benguria et al. (2018) in the context of Brazil's commodity cycles. These historical concentrations of agricultural crops are persistent due to the accumulation of expertise and economic activity over long time periods, as well as physical characteristics of the regions such as climate and soil. Similar to methods employed by Bartik (1991) and Blanchard and Katz (1992), this strategy overcomes the reserve causality problems inherent in a simple regression of firm creation on changes in local income. In our case, the primary concern is that unobserved shocks to investment opportunities of a particular segment in the population could mechanically impact local income.

We start by formulating our hypotheses through a novel three sector model of a local economy which combines the Lucas (1978) insights of individual entrepreneurial choice with models of heterogeneous firms and firm entry, such as Krugman (1979), Melitz (2003a), and Chaney (2008). The model shows theoretically that commodity price shocks can lead to increased local employment and aggregate income, which in turn increases the profitability of firms in the non-tradable sector catering to the local economy. This increased profitability can in turn lead employees to transition from paid employment to entrepreneurship, generating new firm creation in the non-tradable sector. The model emphasizes individual heterogeneity of the local population and the extent to which new firm creation depends on the willingness of individuals to transition to entrepreneurship. This motivates

[1] Brazil is among the largest producers in the world of coffee, sugarcane, orange juice, soybean, corn and ethanol, among others. These crops provide the basis for the large agribusiness industry in Brazil, which represents 22% of Brazil's GDP, a third of its employment, and almost 40% of its export (PwC, 2013).

the main analysis of the paper, in which we explore the characteristics of individuals responsible for local entrepreneurial responsiveness.

We explore the model's predictions empirically and find that increases in commodity prices in affected municipalities do lead to a significant increase in local employment and aggregate income. Our estimated effects are economically meaningful. At the top 10% of commodity price increases, municipalities experience a 7.8% increase in local aggregate income and a 6.9% increase in local employment. As shown explicitly in our model, this increase in local aggregate income may create new investment opportunities in the non-tradable sector, which is heavily dependent on local demand (Basker and Miranda, 2016; Mian and Sufi, 2012b; Stroebel and Vavra, 2014), and may lead some paid employees to switch into entrepreneurship. Consistent with the predictions of the model, we find that the local demand shock does trigger significant firm entry, driven almost entirely by increases in the non-tradable sector, with the number of local firms increasing by 4.9%.[2]

We then turn to our main question, and explore the characteristics of those entrepreneurs who respond to local demand shocks by forming new firms. We find that such entrepreneurs are almost exclusively young individuals. Specifically, we find that within municipalities that experience a commodity price shock, entrepreneurship increases by almost 15% among individuals at the bottom quartile of the age distribution, while there is essentially no response for older individuals. These results are robust to the inclusion of industry fixed effects and a variety of covariates controlling for other demographic characteristics which may be correlated with age.

These results are consistent with the idea that lifecycle considerations strongly influence an individual's decision to respond to new local economic opportunities. In particular, younger individuals have been shown to have higher degrees of risk tolerance than older individuals, and thus may be better able to tolerate the risk associated with a fast transition to entrepreneurial activity (Kihlstrom and Laffont, 1979b; Miller, 1984b; Levesque and Minniti, 2006). Likewise, young individuals may have less constraints in the form of family or looming retirement needs, and may therefore have sufficient flexibility to quickly respond to changes in economic opportunities. Finally, younger individuals, being at the early stage of their career, may have less attractive outside options, which may enhance their flexibility to respond to new economic opportunities. These effects appear to outweigh other potentially countervailing lifecycle forces, such as younger individuals being relatively less experienced or more financially constrained.

[2] This result reflects the increase in the number of formal sector firms. Using an annual large scale survey of the Brazilian Institute of Geography and Statistics, we find that firm entry response to the local demand shock is fully concentrated in the formal sector. There is no apparent response by firms in the informal sector.

Interestingly, we find that entrepreneurs who respond to local economic shocks are significantly younger than the average entrepreneurs in the economy. While roughly 40% of the new entrepreneurs in Brazil are at the bottom quartile of the age distribution, we find this to be the case for more than 60% of the entrepreneurs responding to the demand shock. This is again consistent with the notion that the ability to rapidly respond to exogenous changes in market conditions requires a degree of flexibility and risk tolerance that is uniquely possessed by the young.

While the results so far suggest that lifecycle considerations are important, it turns out that being young in itself is insufficient to explain the entrepreneurial response. Instead, we find that skills matter as well. First, we find that among the young, more educated individuals are more responsive to local economic shocks by forming new firms. Moreover, following Autor et al. (2003) and Levine and Rubinstein (2017) we use occupational data to identify occupations that involve significant non-routine cognitive skills, such as creativity and problem solving, as well as complex interpersonal skills such as negotiation and management. We find that among the young, individuals who previously worked in positions requiring such managerial and general business skillsets are significantly more responsive to the local demand shock. We finally provide evidence that it is not simply innate skill which seems to matter. Those individuals with greater occupational experience are more responsive than those with less. On the other hand, we find that skilled but older individuals are not responsive to the local shock.

Next, we compare the skills of the entrepreneurs who respond to local demand shocks with the skills of the average new entrepreneur and the overall population. Focusing on young individuals, we find that the average new young entrepreneur is slightly more skilled when compared to the average young person in the population, as measured by experience, education, and engagement in cognitive non-routine occupations. However, these skill traits are considerably more pronounced among the responsive entrepreneurs who form businesses when local opportunities arise.

In sum, we find that entrepreneurial responsiveness to local economic opportunities is concentrated among the young and the skilled. These findings are consistent with various theories that argue that entrepreneurship requires a variety of general business and managerial skills (Evans and Leighton, 1989; Lazear, 2005).

Our finding that both age and skill matter for the individual-level decision of whether to become an entrepreneur when new opportunities arise suggest that several characteristics of the local economy may affect its entrepreneurial responsiveness. First, since the ability to create new firms hinges on access to finance (Evans and Jovanovic, 1989; Hurst and Lusardi, 2004), and since young individuals have less time to accumulate wealth, we posit that in municipalities with better access to finance, we are likely to find an even stronger entrepreneurial response of the young. Moreover, Lucas (1988) and Gennaioli et al. (2012) argue that the presence of other skilled individuals generates human capital externalities and knowledge spillovers, making it easier for potential entrepreneurs to learn how to start a business. Given the importance of skill we document in our empirical findings, these theories suggest that the overall stock of entrepreneurial knowledge might impact the firm creation response.

We find support for both of these hypotheses by comparing the individual response across municipalities. Younger individuals are indeed more responsive in municipalities with better access to finance, as proxied for by the per capita number of banks. Consistent with the importance of human capital externalities, younger individuals are also more responsive in municipalities where the population is endowed with more skilled individuals, measured by the average number of years of education, and the share of entrepreneurs in the population.

We conclude by discussing some additional considerations related to our findings. We first evaluate the role of the informal sector in the entrepreneurial response. Using an annual large-scale survey dataset, we find no evidence that the number of informal firms and informal workers increase following the local demand shock, in sharp contrast to the formal sector response. This result, along with our previous findings, are consistent with the findings of La Porta and Shleifer (2008) and La Porta and Shleifer (2014). Using data from World Bank surveys, these studies show that informal firms in developing countries tend to be small and are significantly less productive than formal sector firms. They argue their results support a dual view of developing economies, in which informal sector firms arise primarily out of poverty, while economic growth and dynamism comes from a formal sector comprised of productive firms run by skilled, highly educated entrepreneurs. This is exactly what our study documents. When new economic opportunities arise due to increases in local demand, it is almost exclusively young, educated, and experienced entrepreneurs in the formal sector with the requisite business and cognitive skillsets who take advantage of them, just as the dual view of formality and informality would suggest.

Finally, we consider the implications of our findings for the impact of demographic change on entrepreneurial responsiveness. Over the past 50 years, there has been a marked trend in both developed and developing economies towards aging populations. This trend is widespread, stemming from both declines in fertility rates and increased longevity. Our findings that young individuals are more responsive to local opportunities when they arise suggest that this phenomenon may impact the entrepreneurial responsiveness of the economy. Moreover, the importance of acquired skills as well as age implies the possibility of additional indirect equilibrium effects amplifying the direct effect. These could arise, for example, from the local knowledge spillovers proposed by Gennaioli et al. (2012) or the slower speed in an aging population move up the equilibrium job ladder and thereby acquire the requisite business and managerial skills (Liang et al., 2014).

Our work relates to several strands of literature. First, as mentioned above, a variety of macroeconomic studies have emphasized the crucial role that new firm creation plays in the amplification and propagation of aggregate economic shocks.[3] To the best of our knowledge, our study is the first to shed light on the characteristics of the entrepreneurs who respond to economic shocks by creating new firms. Our micro-level evidence highlights the importance of individual level heterogeneity, suggesting that the demographic characteristics of the local population may affect the entrepreneurial responsiveness of the economy.

Second, our paper contributes to a long-standing literature on the nature and characteristics of entrepreneurs.[4] Closely related to ours is Levine and Rubinstein (2017) who find that the firms run by (incorporated) entrepreneurs are likely to engage in tasks requiring comparatively strong non-routine cognitive abilities and that entrepreneurs who incorporate had higher test scores and engaged in more illicit activities in their youth. Relatedly, Azoulay et al. (2017) find that successful entrepreneurs are experienced and middle-aged, rather than young. We complement these studies by focusing instead on responsive (Kirznerian) entrepreneurs who start a business in reaction to exogenous local economic shocks. We find that these individuals are significantly younger than the average entrepreneur in the population, and that they are also more skilled and experienced. Our evidence highlights the importance of both life-cycle considerations and human capital as important drivers of the entrepreneurial responsiveness of the economy to aggregate shocks.

Third, our paper relates to a vast literature studying the role of entrepreneurship in developing

[3]General equilibrium models of monopolistic competition linking firm entry and exit to aggregate fluctuations indicate the presence of various channels. Devereux et al. (1996), Chatterjee and Cooper (2014), and Bilbiie et al. (2012) are examples of models where entry of new firms generates greater product variety, while in Jaimovich and Floetotto (2008) entry works through increased competition and lower markups. In related recent work, Clementi and Palazzo (2016) argue that increases in firm entry in response to aggregate shocks lead to large and persistent expansions because of lifecycle considerations. Sedlácek (2014) suggest the lack of startups during a downturn can lead to persistent employment declines in the economy, and Sedlacek et al. (2017) show that firm heterogeneity, and particularly the presence of high-growth startups, are key for aggregate gains. Several empirical studies further highlight how new and young firms act as important sources of job creation and employment (Haltiwanger et al., 2013b; Pugsley and Sahin, 2015). In particular, Adelino et al. (2017) use US Census micro-data and regional variation in investment opportunities through Bartik shocks to show that it is the young and new firms that create the most jobs in response to positive local demand shocks.

[4]See, for example, Kihlstrom and Laffont 1979b; Blanchflower and Oswald 1998; Hamilton 2000; Moskowitz and Vissing-Jorgensen 2002; Hurst and Lusardi 2004; Hombert, Schoar, Sraer and Thesmar 2014; Humphries 2016.

economies. Important contributions to this literature include De Mel et al. (2008b); Bruhn et al. (2010); Naudé (2010); Schoar (2010b); Desai (2011); Bianchi and Bobba (2012) and McKenzie and Woodruff (2013). As mentioned, of particular note are La Porta and Shleifer (2008) and La Porta and Shleifer (2014), which use World Bank surveys to study the characteristics of entrepreneurs and the businesses they run in the formal and informal sectors of developing economies. Relatedly, Ulyssea (2018) focuses on Brazil and integrates various theories of informality.

Finally, our paper contributes to a growing strand of literature that seeks to understand how demographic changes affect macroeconomic patterns and labor market dynamics.[5] Our findings that young individuals are more responsive to local opportunities when they arise suggest that this trend may impact the entrepreneurial responsiveness of the economy. In that regard, our paper is also related to Kopecky (2017), who explores the relationship between aging populations and entrepreneurship in the United States.

The remainder of the paper proceeds as follows. Section II provides our theoretical framework. Section III describes the various data sources used in the analysis, while Section IV describes the empirical strategy that combines local historical endowments of agricultural production with current movements in global commodity prices. Section V presents our municipality-level aggregate results. Section VI describes the individual-level analysis and reports the key results of the paper. Finally, Section VII builds on our main findings and tests several theories suggesting that characteristics of local economies may affect entrepreneurial responsiveness. We test these theories using cross-municipality differences. This section also discusses the effects of demographic change and the role of the informal sector. Section VIII concludes.

II. Theoretical Framework

To motivate our empirical analysis, we construct a two-period, three sector model of a local economy which combines the Lucas (1978) insights of entrepreneurial choice with models of heterogeneous firms and firm entry (Krugman (1979); Melitz (2003a); Chaney (2008)). The model features exogenous profitability shocks to the local resource sector. We provide the exact mathematical details of this model in the appendix. Here, we describe the basic structure of the model and its key predictions.

The local economy comprises three sectors, producing commodity goods, tradable goods, and

[5] For example, see Jaimovich and Siu (2009); Jones (2010); Backus et al. (2014); Gagnon et al. (2016); Engbom (2017).

local non-tradable goods. The commodity and tradable sectors provide a single homogenous good, while the local non-tradable sector is comprised of a continuum of goods differentiated by varieties.

We assume that all individuals in the local economy have Cobb-Douglas preferences over the tradable and non-tradable goods, with non-tradable consumption being given by a standard CES aggregator. This implies that all individuals spend a constant fraction of their total income on tradable goods and a constant fraction on the non-tradable composite. For simplicity, we assume that they do not consume the commodity product. Each individual inelastically supplies one unit of labor. A fraction φ of individuals, however, have a choice over their occupation along the lines of Lucas (1978). They can either provide a single unit of labor, earning the prevailing wage, or choose to become an entrepreneur in the non-tradable sector, producing a single differentiated variety.

Intuitively, these individuals faced with the entrepreneurial choice are those who are either sufficiently capable or sufficiently willing to become entrepreneurs in response to new economic opportunities. Of course, they will only choose to actually become entrepreneurs if it is sufficiently profitable. A key aspect of our empirical work will be to determine the characteristics of those individuals who become entrepreneurs when opportunities arise.

We assume that this fraction φ of the population face heterogeneous non-pecuniary fixed costs associated with becoming an entrepreneur. We interpret non-pecuniary costs broadly, as these could arise from risk aversion related to entrepreneurship, family obligations, mental stress, etc.[6]

Finally, we assume that labor is perfectly mobile within the overall economy, which essentially means that we take the local wage as exogenous. We further assume, however, that entrepreneurs must come from the existing local population at the beginning of the model's timeline.[7]

We assume that the commodity and tradable sectors are perfectly competitive, each with a composite firm hiring workers to produce a single homogeneous good. The prices of the commodity and tradable goods are set by global demand and are thus taken to be exogenous. As is standard in models of heterogeneous firms, entrepreneurs operating in the non-tradable sector compete via monopolistic competition. Each entrepreneur hires labor and operates a CRS production technology.

[6]Specifically, we assume that for the fraction φ of individuals capable of becoming an entrepreneur, the distribution on non-pecuniary fixed costs F is given by $G(F)$. Of course, the initial binary determination of whether one can be an entrepreneur or not, represented by φ, likely also depends on non-pecuniary costs, in addition to characteristics related to one's ability to engage in entrepreneurship. Allowing for this second form of heterogeneous non-pecuniary costs is simply useful for tractability and expositional reasons.

[7]Intuitively, we are assuming that only the local population have sufficient local knowledge so as to be able to take advantage of new local economic opportunities when they arise. Indeed, empirically we find that individuals outside the municipality do not contribute to firm creation in response to the local commodity shocks. Nevertheless, relaxing this assumption would not change the results or key implications of the model at all, but would complicate matters since it would involve modeling the rest of the overall economy as a closed system.

In equilibrium, firms and individuals optimize, supply equals demand for labor, and the marginal entrepreneur must be indifferent between labor and entrepreneurship.

Now suppose that there is an exogenous increase in the price of the commodity good in period 2. We find the following result. All proofs are in the appendix.

Proposition 1. *An increase in the price of the local commodity good leads to increased employment and new firm creation in the local non-tradable sector.*

To understand this result, first suppose that the number of entrepreneurs is fixed at its initial level. The higher price raises the marginal revenue productivity of the commodity sector . In the absence of labor mobility, this would raise wages. However, since workers are perfectly mobile, the increased revenue productivity leads to in-migration of workers until the marginal revenue productivity of the commodity sector is equal to the exogenous wage. The amount of labor employed by the tradable sector remains unchanged. This inflow of workers raises aggregate income in the local economy, which increases the demand for non-tradable goods by the local population. Since demand is homothetic and marginal costs are unchanged, the price of the non-tradable goods does not change. Therefore, there is an increase in output and higher employment in the non-tradable sector. Under the assumption that the number of entrepreneurs does not change, this would lead to higher entrepreneurial profits.

However, this in turn would then imply that entrepreneurial profits are now higher than worker wages, which remain fixed. Thus, if we now allow for the number of entrepreneurs to adjust, there will be firm entry. Local workers who are capable/willing of entrepreneurship, i.e. those in the fraction φ of the initial local population, and those with sufficiently low non-pecuniary costs will become entrepreneurs, increasing the number of differentiated varieties and reducing entrepreneurial profits through greater competition. This will continue until the the marginal entrepreneur is again indifferent between entrepreneurship and labor.

We explore these dynamics in Section V in the paper, illustrating how local demand shocks affect local income and employment across sectors, as well as the dynamics of firm entry. We find that local commodity shocks do indeed lead to increased employment (driven partly by employee migration) and local aggregate income, as well as increased firm entry in the non-tradable sector. The model also implies the following proposition:

Proposition 2. *If the stock of potential entrepreneurs increases, there is more firm entry and the employment increase occurs more on the extensive margin than the intensive margin. That is, more* *of the employment creation occurs within new firms rather than within incumbent firms*

This result is intuitive. The larger the population willing and capable of entrepreneurship, the larger the number of individuals that are able to take advantage of new economic opportunities, leading to higher firm entry. If there is more firm entry, then the increase in output and employment will be to a greater extent accommodated by new non-tradable firms, rather than existing ones.[8] This second proposition indicates that local demographics can affect the firm entry response, to the extent that those individuals willing and capable of starting a new business in response to economic opportunities are concentrated among certain demographic segments of the population.

This motivates our key goal, which is to explicitly characterize the demographic determinants of those individuals characterized by φ. In Section VI, we study this question at the individual level, relating the propensity to respond to new opportunities through entrepreneurship to age, education, and various skills acquired through previous employment. In Section VII, we further address the determinants of φ, evaluating how municipality-level characteristics such as local financing constraints and local human capital and knowledge spillovers might impact the ability of individuals to create new businesses when opportunities arise. In Section VII, we also address how recent widespread demographic trends might impact the entrepreneurial responsiveness of an economy.

III. Data

In this section we discuss the main datasets used in our analysis. We start by describing the RAIS dataset, which provides matched employer-employee information on all employees in the formal sector in Brazil. We supplement this data with data on municipal agricultural crop endowments, as well as data on global commodity prices. Additional data are discussed in the analysis part of the paper.

A. Employer-Employee Data

The RAIS database (Relacao Anual de Informacoes Sociais) is an administrative database from the Brazilian Ministry of Labor (MTE), which provides individual level data on the universe of formal sector employees in Brazil. RAIS is widely considered a high quality Census of the Brazilian formal

[8] In this model, the increase in output and employment is independent of the amount of firm entry. Firm entry determines the margin on which the increases occur. Consumer welfare, however, does depend on the amount of firm entry, since consumers benefit from greater product diversity. That output and employment increases are independent of firm entry is due to the model's constant markups. If markups decrease as competition increases, as in Jaimovich and Floetotto (2008), then more firm entry would be associated with a larger employment and output boom.

labor market (Dix-Carneiro, 2014). The database, created in 1976, is used by several Brazilian government agencies (such as the Brazilian Central Bank) to generate statistics for the Brazilian economy. The RAIS database also forms the basis for national unemployment insurance payments and other worker benefits programs. As a result, ensuring the accuracy of the information is in the interest of both firms (who would otherwise be subject to monetary fines) and individuals (who want to be eligible to receive government benefits), as well as the central government.

RAIS contains information on the firm and the establishment of each employee, including tax identifiers, location, industry, and legal status. At the individual level, RAIS includes employee-specific identifiers, which allow individuals to be tracked over time and across firms (as well as across establishments of the same firm).[9] Similar to other employer-employee matched data, for each employee we observe payroll, tenure in the firm, and hiring and firing dates. RAIS additionally has rich personal data on gender, nationality, age, and education, as well as a few less commonly available variables such as hours worked, reasons for hiring and firing, and contract details. Finally, each employee is assigned to an occupational category specific to her current job. There are 2,511 such categories, which follow the detailed Brazilian's classification of jobs (Classificacao Brasileira de Ocupacoes - CBO), which is similar to the International Standard Classification of Occupations (ISCO-88).

Using data on occupations, we are able to identify individuals that are managers or CEOs of a firm, as well as lower ranked workers, both blue collar and white collar.[10] Following standard practice in the entrepreneurship literature (e.g. Kerr et al. 2015; Babina 2015), we define an entrepreneur as the CEO or the top paid manager of a new firm in the year of birth. If no worker is classified as CEO or manager, we use the highest paid worker in the firm. In the text, we use the terms "entrepreneur" and "founder" interchangeably.

Furthermore, following Autor et al. (2003), Gathmann and Schönberg (2010), and Levine and Rubinstein (2017), we distinguish between workers who perform different types of tasks. *Non-routine cognitive* tasks require creativity and problem-solving ability, as well as negotiation, management, and coordination skills. *Non-routine manual* tasks require physical work together with the ability

[9]Individuals with multiple jobs in a given year therefore appear multiple times. Following standard practice in the literature (Menezes-Filho, Muendler and Ramey, 2008), we keep only the highest paying job of the individual in a given year. If there are two or more such "highest paying" jobs, we break ties by keeping the earlier job.

[10]We match the CBO classification to the International Standard Classification of Occupations (ISCO-88) using the procedure outlined in Muendler et al. (2004). This correspondence allows us to categorize workers into four organizational layers, following a framework close to Caliendo and Rossi-Hansberg (2012). From bottom to top layers they are: Blue Collar, White Collar, Managers, CEOs. Occupation data are missing for about 6% of the sample. Please see Colonnelli and Prem (2017) for more details on the data construction.

to adapt to different situations. Finally, *routine* tasks are all other tasks based on well-specified processes and activities.

The analysis samples are constructed as follows. We focus on individuals that are within the ages of 18 and 65, and who have wage data in RAIS for at least 3 years during the period 1993-2014, to reduce the effects on our results of individuals who are not strongly attached to the labor market. Under these restrictions, the sample includes roughly 80 million individuals. In the municipality-level analysis, we aggregate these data across the 5,570 municipalities in Brazil, and we restrict the sample further to municipalities with a population less than 500,000.[11] We then focus on municipalities that have positive crops production at any point in time and derive a final sample of 5,443 municipalities. In the individual-level analysis, we additionally restrict the sample to individuals who we can clearly link to a specific municipality at the time of the shock; that is, at any given year, we keep individuals who were working in the same municipality the previous year as well. From this set, we finally extract a random 10% sample of the these data to overcome computational barriers. All analysis focuses on the period 1998-2014, since we rely on the prior 5 years (1993-1997) to construct the agricultural historical endowment for each municipality, as discussed in Section IV. All statistics in the paper refer to these samples.

In Panel A of Table V.B, we provide summary statistics information on the relative importance of Brazilian industries. The two largest industries in the economy are the non-tradable and services sectors, which capture 48.9% and 26.3% of the annual number of firms, and 24.8% and 37.2% of annual employment, respectively. Panel A also documents the annual creation of new firms across industries, with most new firms being created in the non-tradable and services sectors.

In the empirical analysis, we focus on municipalities as the local economic unit and explore how municipalities respond to plausibly exogenous economic shocks triggered by fluctuations in global commodity prices. Panel B of Table 1 provides municipality level summary statistics. The average municipality in the sample has a population of 23,680 and a GDP per capita of 3,093 (USD 2000). There is an average (median) of 274 (64) firms and an average (median) total number of formal private sector employees of 4,214 (850) per municipality, with significant dispersion in size across regions. The average (median) number of new businesses created in a given municipality in a given year is 33 (7). Once again, there is a significant heterogeneity across municipalities.

Panel C of Table 1 provides summary statistics at the individual level. On average, we find that

[11]This restriction drops 30 municipalities and has essentially no impact on the results. We use this restriction to overcome computational constraints in the individual level analysis.

in any given year there are 2.9 founders per each 1,000 employees. Moreover, 61% percent of all workers are male (57% among the founders). Based on the occupational status of the workers, we find that most workers can be characterized as either Blue Collar (48%) or White Collar (42%), while only a small fraction consists of Managers and CEOs (4%). Founders have similar occupational characteristics, as computed in the year before founding a firm. Additionally, we find that 32% of the workers have less than high school education, 47% of the workers graduated from high school, and the remaining 21% have higher education. The set of entrepreneurs appears to be more educated, as seen in the significant differences among the set of individuals having less than high school education. Finally, the median (average) worker is 34 (35.6) years old, while the median new entrepreneur is significantly younger at 30 (31.9) years old.

B. Agricultural Crops in Brazil

The Brazilian economy relies heavily on agriculture. For example, Brazil is among the largest producers in the world of coffee, sugarcanes, orange juice, soybean, corn and ethanol. These crops, and others, provide the basis for the large agribusiness industry in Brazil, which represents 22% of Brazil's GDP, a third of its employment, and almost 40% of its export (PwC (2013)). The agribusiness industry captures not only farming production, but also the supply of farming inputs such as machinery and seeds, as well as the selling and marketing of farm products, such as warehouses, wholesalers, processors, and retailers.

The empirical strategy in this paper relies on local demand shocks caused by fluctuations in the profitability of the local agricultural sector driven by global commodity prices. We obtain information on agricultural crops from the Brazilian Institute of Geography and Statistics (IBGE), which is responsible for the census as well as most of the statistical analyses of the Brazilian economy. The data provide the annual production of all different agricultural crops, at the municipality level, for the period 1993-2014. We standardize the different crops to the same unit measure (i.e., tons) to construct a panel dataset of the universe of agricultural crops production by Brazilian municipalities.

Panel B of Table 1 illustrates that the average aggregate dollar value of local crops in a municipality is equal to approximately 120% of local GDP, with the median equal to 15.6% of local GDP. Similarly, the value of local crops per capita is on average \$3,038. Figure 1 illustrates the wide spatial distribution of agricultural resources across municipalities. Municipalities are divided into quintiles based on the production value of natural resources relative to GDP in the year 2000. The bottom quintile has production values of roughly 1% to 5% of municipality GDP. In contrast, in the top quintile, municipalities have production values worth more than 45% of local GDP. The figure illustrates significant heterogeneity across municipalities. In fact, the heterogeneity across municipalities is even wider, given that different municipalities specialize in different portfolios of agricultural products, but this is not reflected in the figure.

International commodity prices are obtained from the Global Economic Monitor (GEM) Commodities database of the World Bank, which covers our full sample period. For each crop, we create a yearly measure of commodity prices by taking the average price within the year. In some cases, there may be a single price that matches to multiple crops. For example, the price of tea is assigned to both "indian tea" and "yerba mate." Hence, we consolidate several agricultural crops to match prices, and drop cases where we cannot establish a match between crops and commodities. We standardize all units of measure to US dollars per ton. In the final dataset, we have 17 different commodities present in Brazil which are traded on the international commodity markets. The detailed presence of these agricultural commodities across municipalities and their total value per municipality is provided in Table A.1.

IV. Empirical Strategy

We aim to study the entrepreneurial response to new local opportunities generated by fluctuations in local income. Simply running regressions of new firm creation on local income, however, is confounded by reverse causality concerns. In particular, unobserved shocks to the investment opportunities of particular sets of individuals could mechanically impact local income. For example, the introduction of local government programs providing start-up incentives to the young would likely increase both the firm creation rate of the young as well as local income. To the extent that such programs are unobserved by the econometrician, regressions of firm creation on local income would reflect this reverse causality.

To address this issue, we create a measure that isolates exogenous changes in municipality level local income over time. To do so, we identify fluctuations in the value of locally produced agricultural commodity crops, and thus also in the profitability of the local agricultural sector, by interacting the local agricultural endowment with movements in global commodity prices. Such commodity price fluctuations are an important source of economic variability for emerging economies, as well as for developed economies rich with natural resources (Fernández et al. (2018), Allcott and Keniston (2017)). Moreover, as shown by Allcott and Keniston (2017) in the context of US oil and gas booms and by Benguria et al. (2018) in the context of Brazil, such shocks do appear to increase local demand, leading to increased employment in the local non-tradable sector.

The agribusiness sector in Brazil is large, highly developed, and highly diversified. Different municipalities are endowed with different types of agricultural crops that they can grow locally. We calculate the local value of a crop in a given year as the product of the local crop quantity (Q) with its unit price (P) in international commodity markets. While international prices are likely exogenous to current municipality-specific economic conditions, quantities are less likely to be so. We therefore hold endowments fixed, prior to the start of our sample period, so as to remove the endogenous component in the fluctuations of commodity values. We construct a proxy for the local endowment by averaging production quantities in the five years preceding the beginning of our analysis sample, i.e. between 1993-1997. Using this approach circumvents potential endogeneity concerns because historical production is likely to capture the (exogenous) spatial endowments of agricultural crops, rather than potentially endogenous production activity, which may correlate with unobserved local shocks. This approach is standard in the literature (see, for example, Dube and Vargas (2013)). These historical endowments of agricultural crops are persistent due to the accumulation of local expertise and economic activity over long periods of time, and because of the physical characteristics of the regions such as climate and soil.

Specifically, let $Q_{kj,98}$ be our proxy for the regional endowment of crop k in municipality j, measured by the average production in the years 1993-1997. Let P_{kt} be the international price of crop k in year t. The annual Crops Index (CI) for municipality j in year t is the sum over all crops of time-invariant local agricultural endowments, multiplied by the respective time-varying international prices:

$$CI_{jt} = \sum_{k} Q_{kj,98} * P_{kt} \tag{1}$$

The endowment part of the formula, $Q_{kj,98}$, generates cross-sectional variation in the pre-existing exposure of different municipalities to different agricultural resources. International commodity price fluctuations generate time-series variation that is plausibly independent of shocks to local investment opportunities. Together, they provide a municipality-year varying series of exogenous demand shocks generated by the differential exposure of different Brazilian municipalities to the changing global value of agricultural commodities.

Our empirical strategy is inspired by the shift-share approach of Bartik (1991) and Blanchard and Katz (1992), which interacts local manufacturing shares with national trends in manufacturing employment to identify local income and demand shocks.[12]

The primary identification concern with this approach is that unobserved municipality level shocks in Brazil could impact global commodity prices, biasing the results. For example, one such concern is that local government programs designed to incentivize new firm creation in specific municipalities might also lead to increased local agricultural output, driving down international prices. We address this concern in Section V.B, finding that this is unlikely to be a problem in our context.

We examine the impact of local endowment shocks in the top 10th percentile of crops index fluctuations within a municipality. Specifically, we estimate the model:

$$\ln(CI_{jt}) = \alpha_j + \delta_t + u_{jt}, \tag{2}$$

and for each municipality year we define the shock as $\hat{u}_{jt}$, which allows us to capture deviations from municipality averages and aggregate variations over time. Figure 2 illustrates the variation we observe in the value of municipal endowments of crops, as captured by this index. The thin grey lines provide the time series for a 10% random sample of municipalities in our sample. The other lines are median (solid line), 10th and 90th percentiles (dashed lines) of the distribution of residuals in each year. As the figure illustrates, there is both significant cross-sectional variation within a given year and considerable time variation within a given municipality in the value of agriculture commodities.

We then let let Z_{jt} be equal to one if $\hat{u}_{jt}$ is in the top 10th percentile of its distribution, and equal to zero otherwise. We consider municipality j to be "treated" in year t if $Z_{jt} = 1$. As we discuss in Section VI, the choice of a binary shock allows us to transparently estimate the characteristics of the individuals who create new businesses in response to local demand shocks, and to compare these characteristics both to the average worker and the average entrepreneur in the economy. This choice, however, is not driving any of our findings. Both at the municipality and individual level, the results are extremely robust to the use of a continuous measure of the index $\ln(CI_{jt})$, as well as alternative binary versions of the shock that rely on different thresholds (e.g. top 25th percentile). We further discuss these and other robustness tests in Section V.B.

[12]This strategy has been widely adopted by the economics literature. See, for instance, Gallin (2004); Saks and Wozniak (2011); Diamond (2016), and Adelino et al. (2017).

V. Municipality-Level Analysis

We start by estimating the impact of global commodity price fluctuations on municipality level economic activity. As discussed above, our strategy interacts this time-series variation with cross-sectional differences in municipal endowments of agricultural crops; that is, we use municipality-year level variation in our crops index from equation 2 as a source of plausibly exogenous fluctuations in local income and demand. Specifically, we estimate the following model:

$$Y_{jt} = \alpha_j + \delta_t + \beta Z_{jt} + \gamma X_{jt} + u_{jt}, \tag{3}$$

where Y_{jt} is the outcome of interest, α_j are municipality fixed effects, δ_t are year fixed effects, Z_{jt} is the binary shock described earlier, and X_{jt} control for log-population.[13]

A. Local Employment and Firm Creation

The main results are presented in Table 2. We find that positive shocks to the value of local crops generate both higher income and higher employment in the treated municipalities. Treated municipalities experience a highly significant increase of 6.9% in the level of formal employment (column 1). In Table A.2 in the Appendix, consistent with the model of Section II, we find that part of the increase in employment is driven by both migration to the municipality from other regions, as well as entry of new individuals into the labor force. In column 2 of Table 2, we find that the increase in local employment translates into a highly significant increase of 7.8% in total local income, as measured using aggregate payroll across all local firms.

As we illustrated through the theoretical framework of Section II, higher levels of local income suggest new profit opportunities available to be exploited by potential entrepreneurs, particularly in those sectors which are highly dependent on local demand conditions. We see that the commodity price shock does indeed lead to an increase in the total number of local firms. As reported in column 3 of Table 2, there is a statistically significant increase of 4.5% in the number of local firms following the shock. This increase is primarily driven by the creation of new firms, rather than a higher likelihood of survival of existing firms, which instead seems unaffected given the small and statistically insignificant effect on firm closures (column 4).

[13] In most specifications, we use the natural logarithm of the variable of interest. The sign and significance of our results are robust to using $\ln(1+x)$ as dependent variable (where x is the outcome of interest in levels): while the latter variable definition has the advantage of keeping the number of observations constant across specifications, it also makes it harder to quantitatively interpret the coefficients. For this reason, we present results where the simple natural logarithm is used instead.

Table 3 illustrates the impact of the shock by economic sector, which we categorize using the Brazilian CNAE industry codes into Agriculture and Mining (columns 1), Manufacturing (columns 2), Non-tradable (columns 3), and Services (columns 4).[14] Panel A focuses on employment, and shows a statistically significant increase in employment levels in all sectors. As illustrated in column 1, this finding is consistent with rising commodity prices having a positive direct effect (11.6%) on the sectors responsible for the production of these commodities (Agriculture and Mining). Moreover, the evidence points to the presence of positive spillover effects to other sectors. The rise in local income seems to lead to an increase in demand for local goods and services, as illustrated by the rise in employment in the non-tradable and services sectors. When studying the aggregate sectoral impact on number of firms, in Panel B, we find that the vast majority of new firm creation is accounted for by firms in the non-tradable sector (column 3), where we observe a highly statistically significant increase of 5.8%, compared to a small 1.8% in Agriculture and Mining and even smaller and statistically insignificant effects on other sectors.

Our aggregate results emphasize the importance of entrepreneurship for the dynamics of local economic activity. All of these findings, moreover, are consistent with the model presented in Section II, in which shocks to the commodity sector increase local employment and local income, subsequently leading to a strong entrepreneurial response in the local non-tradable sector. Our findings are also consistent with Adelino et al. (2017), who study the US and similarly find that local income shocks lead to a significant response by new firms in the non-tradable sector. All together, these findings provide a preliminary step towards our main analysis, in which we study the individual entrepreneurs who account for the firm creation response.

Finally, we also explore the characteristics of the newly created firms following the shock. This test aims to understand whether these new firms are short-lived, and therefore contribute little to long-run employment creation, relative to the average new firms in the economy. We explore these concerns in Table 4. We construct a dataset at the firm-level covering all firms in the economy at their year of entry. We then estimate a specification where the dependent variable is an indicator (scaled by 1,000) for whether the firm survives for at least 1, 2, 3, and 5 years.[15]

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[14] In particular, we start from the classification used by Dix-Carneiro (2014), but combine High and Low Tech Manufacturing into Manufacturing, and Construction and Trade into Non-tradable. We drop Transportation/Utilities/Communications from the analysis.

[15] The precise specification is:

$$S_{fjt} = \alpha_j + \delta_t + \beta Z_{jt} + u_{fjt}$$

where α_j are municipality fixed effects, δ_t are year of entry fixed effects, and Z_{jt} is our top 10% binary shock. Standard errors are clustered at the municipality level.

We find that, if anything, firms created in response to the local demand shock are (slightly) more likely to survive after 2, 3 and 5 years. While survivorship just proxies for firm success, these results provide suggestive evidence that new firms created in response to local demand shocks play an important role in driving the persistence and propagation of aggregate economic fluctuations. Such findings are consistent with Sedláček and Sterk (2017), who find that firm success is influenced by aggregate conditions at the time of entry.

B. Robustness and Additional Results

In this subsection, we describe additional tests to probe the robustness of the results and provide further characterization of the main aggregate effects. All tests are reported in the Appendix.

Influencing Global Commodity Prices

The key endogeneity concern with our approach is that the local agricultural sector is sufficiently large relative to global production so as to potentially influence international prices. If this were true, then unobserved municipality level shocks impacting local firm creation, such as government incentive schemes, might also impact global commodity prices and thus bias the results. Indeed, Brazil is a leading global player in the production of crops, accounting for more than 10% of world's exports for some of them (e.g., sugar cane, coffee, soybeans, yerba mate, tobacco). Nevertheless, it is useful to note that our unit of analysis is at the municipality level, rather than at the national level.

To test the robustness of our results, we re-estimate the main specifications dropping municipalities with high levels of production of specific crops, who may be able to affect global commodity prices. In particular, we complement our municipality level data with data from the United Nations Food and Agriculture Organization (FAO) to compute the share of world production of municipalities across different crops. Panel A of Table A.3 in the Appendix reports the results after dropping 64 municipalities that have ever produced, in any given year, 1% or more of the world production of any commodity in the period 1996-2015. In Panel B we report even more conservative results, obtained after dropping 167 municipalities with at least a 0.5% share of world production at some point in our sample. The results remain unaffected in both cases.

Alternative Definitions of the Shock

Table A.4 in the Appendix reports the main estimation results when we vary our definition of the intensity of local commodity price shocks. We find that all of the main findings continue to hold, when we focus on more moderate local endowment shocks defined as being in the top 25th percentile relative to the municipality mean (second row).

We also find statistically significant negative effects on local economic outcomes when we instead look at negative endowment shocks. In particular, as reported in the third row of Table A.4, when defining a negative endowment shock to be in the bottom 10% of the shock defined as $\hat{u}_{jt}$ in equation 2, we find a 6.5% decline in local employment and a 6.8% decline in local total income. The number of firms falls by 4.0%, driven again by a decline in firm entry instead of increased closures of existing firms. We find very similar findings if we define a negative endowment shock to be in the bottom 25%. These results are reported in row 4 of Table A.4.

Finally, and importantly, all of our results are robust to using a continuous log version of the shock (fifth row), namely $\ln(CI_{jt})$, which estimates the elasticity of new firm creation and other outcomes to the value of the local agriculture endowment. For example, a 10% increase in the value of the local endowment is associated with a 2.1% increase in employment and a 1.4% increase in the number of firms. All estimated effects are highly significant, except for the small and insignificant effects on firm closures.

Persistence of Treatment Effects

Finally, we explore the persistence of the effects generated by the local endowment shocks. We find that the response of new firm creation, and economic activity more generally, to local economic shocks, is persistent but, as we may expect, decreases gradually over time. Table A.5 reports our main results for different *lagged* definitions of the binary treatment variable. While the response is strongest in the year of the shock (especially for new firms), we find that local economic activity continues to positively respond one to four years after the commodity endowment shocks, and then gradually declines.

VI. Individual-Level Analysis

In this section we move to our primary analysis, motivated by Proposition 2 of section II, which aims to determine the key characteristics of those individuals who respond to local demand shocks by creating a new firm. We model the decision to start a business using a binary choice linear probability model. Let the binary indicator variable T_{ijt} denote the decision in year t of an individual i in municipality j to become an entrepreneur, as defined in Section III.[16] Analogous to the previous analysis, we again let $Z_{jt} = 1$ denote an exogenous increase in local demand in municipality j, as proxied for by the local agricultural endowment shocks described earlier. We estimate the following linear probability model:

$$T_{ijt} = \alpha_j + \delta_t + \beta \cdot Z_{jt} + \varepsilon_{ijt}, \tag{4}$$

where α_j denotes municipality fixed effects, and δ_t denotes year fixed effects. Here, β captures the direct effect of the local endowment shock on individual firm creation. Standard errors are clustered at the municipality level. Importantly, in this analysis, we focus on individuals that are already working in the region rather than individuals that migrate from a different region, so as to ensure that we can cleanly identify individuals who directly experience the change in local demand and investment opportunities.

In this section, we focus on the role of age and an individual's life cycle on the one hand, and skill and experience on the other hand, as potential determinants that can explain the entrepreneurial responsiveness of individuals to local opportunities.

A. *The Importance of Lifecycle Considerations*

What determines individuals' entrepreneurial response to aggregate shocks? According to standard models such as Lucas (1978), ability is the relevant dimension along which individuals sort into entrepreneurship. In this type of model, to the extent that ability is an innate characteristics, the age profile of the population does not matter per se. Other theories, however, would predict that age does play a prominent role in the decision to start a business in response to changes in local opportunities.[17]

On the one hand, if ability reflects skills accumulated over time as individuals move up in their career, and such skills are necessary to take advantage of changes in local opportunities, it

[16] In all analysis, we multiply these indicator variables for entrepreneurs by 1,000, to ease the interpretation of the coefficients.

[17] See Parker (2018) for a comprehensive review.

is reasonable to expect that individual responsiveness to aggregate shocks would increase with age (Lazear, 2005; Evans and Leighton, 1989). Similarly, to the extent that downpayment and financing constraints affect the ability to start a new business, older individuals again may be more responsive to new opportunities, having had more time to develop the necessary personal wealth (Quadrini, 1999). On the other hand, young individuals may be the most responsive if, for example, they have a greater tolerance for risk, limited outside options, an overall higher degree of flexibility in their personal and family circumstances, or if they find the time and effort involved in creating a business less costly. [18] Ultimately, the extent to which any of these forces matter, and their relative magnitudes, is an empirical question.

Relying on the econometric framework outlined in the previous section, we take this question to the data by investigating the heterogeneous response of different types of individuals to our specific local demand shocks. In this sub-section, we center our analysis squarely around the role of age. Figure 3 reports the increase in entrepreneurial rates in response to the shock, estimated according to model (4), for different age quartiles. The 25th percentile of the age distribution in the analysis sample is 27, the median is 34, and the 75th percentile is 43.[19] The results clearly illustrate that it is young individuals -those in the bottom quartile of the age distribution- who respond strongly to the shock. The likelihood of becoming an entrepreneur increases by 0.39 (out of 1000) under a positive shock. When compared to the average flow of entrepreneurs in the economy (2.91 out of a 1000), this reflects a 13.4% increase. The response decreases significantly in the second quartile and becomes statistically insignificant by the third quartile. These findings are consistent with lifecycle considerations playing a key role in the individual entrepreneurial response.

We refine this analysis in Table 5, in which we show that the impact of age on the firm creation response is robust to the inclusion of a variety of other demographic characteristics. Column 1 shows the simple entrepreneurial responsiveness to the shock, controlling only for year and municipality fixed effects. As the table reports, the shock leads to an increase of 0.145 (out of a 1000) in the probability of becoming an entrepreneur. This reflects a 5% increase in entrepreneurial activity compared to the average flow of entrepreneurs. In column 2, we add an interaction term between the treatment variable and the young indicator, which is equal to one in the bottom quartile of the age distribution. This column relays the same message as Figure 3. This group of young individuals

[18] See, for example, Miller 1984a; Reynolds and White 1997; Levesque and Minniti 2006; Delmar and Davidsson 2000; Arenius and Minniti 2005; Rotefoss and Kolvereid 2005; Wagner 2006; Bergmann and Sternberg 2007; Uusitalo 2001.

[19] As discussed earlier, our original sample is restricted to individuals between 18 and 65 years old.

exhibit a striking responsiveness, more than 13 times larger, when compared to the rest of the population.[20]

We next show that this result is robust in sign and magnitude to the inclusion of other controls. In particular, in column 3, we add controls for sector fixed effects, an indicator variable for whether the individual as a high school diploma, one for higher education, and an indicator variable for having a white collar occupation.[21] The estimated coefficients barely change. In column 4 we further control for individual outside options prior to the shock, as proxied by the rank of the individual within the wage distribution in the given year; the coefficient on the interaction term remains almost unchanged, and strongly significant, thus suggesting that different outside options between young and old individuals are not driving the higher responsiveness of the young to the shock. Finally, in column 5, we report a specification where we additionally include municipality by year fixed effects, as well as all the individual controls included in column 4, thus comparing similar individuals within the same municipality and the same year who differ in age. The resulting coefficient, albeit smaller than those from the previous specifications, remains positive and strongly statistically significant.

We next compare the distributional characteristics of the responsive entrepreneurs to the average new entrepreneurs in the population. The procedure for doing this is described Section A.2. We find that the average individual who starts a business tends to be younger relative to the overall population, but that this feature is significantly more pronounced among responsive entrepreneurs. As Figure 4 illustrates, roughly 40 percent of individuals who start a new business are in the bottom quartile of the age distribution. However, more than 60 percent of entrepreneurs who respond to the demand shocks are in this same quartile of age. As Figure 4 illustrates, the entire age distribution of the responsive entrepreneurs is tilted towards younger demographics, when compared to the average new entrepreneur in the economy. These results are consistent with the notion that the ability to respond quickly to new economic opportunities depends crucially on flexibility and the willingness to take risks, traits that younger individuals are significantly more likely to possess.

B. Do Skill and Experience Matter?

So far we have illustrated that young individuals are disproportionally more likely to start a business in response to local economic shocks. Lifecycle considerations therefore seem important in

[20]Specifically, the magnitude is obtained as: $\frac{0.032+0.391}{0.032} \approx 13.22$.

[21]All these variables refer to the individual occupations in year $t-1$. Sectors are based on the main categorization into five sectors discussed in Section V.

understanding entrepreneurial dynamics and shock propagation mechanisms. Do skills also affect individuals' entrepreneurial responsiveness to local economic opportunities, as suggested by Evans and Leighton (1989), Lazear (2004), and many others? We evaluate this question by exploring heterogeneity in firm creation *within* the population of young individuals, focusing on several proxies for an individual's skill set.

Table 6 shows that skill and experience are significant determinants of individual responsiveness within the young individuals population. Specifically, we estimate the main specification 4 across various sample splits, with the aim of characterizing skilled versus unskilled individuals within the young population. First, columns 1 and 2 show that responsive entrepreneurs are more likely to have at least a high school diploma. Furthermore, individuals who were previously working in non-routine cognitive occupations are significantly more responsive than others to the rise of local opportunities. Recall that these occupations are those that require creativity and problem-solving and involve tasks related to communcation, negotiation, and managmenent. The effects for this subpopulation, documented in column 3, are significantly larger than the effects for the remaining subpopulation that have not engaged in these types occupations, as shown in column 4. Given this finding, one natural question is whether individuals who already have these skills sort into these occupations or whether individuals gain important relevent entrepreneurial skills from working in such occupations. That is, does experience matter? We test this in columns 5 and 6. We find that having more experience (being in the upper half of the within firm experience distribution in their previous job) makes young people almost 4 times more responsive than those with less experience. All these results are consistent with Lazear (2004) and other empirical studies emphasizing the importance of ability and acquired skills for entrepreneurial responsiveness.[22]

Strikingly, but conceptually in line with our previous results, Table A.7 shows that there is no statistically significant heterogeneous response when we perform the analogous analysis for older individuals. That is, within individuals in the top three quartiles of the age distribution, we do not find that higher skill levels increase entrepreneurial responsiveness to local economic shocks, in contrast to our findings with respect to the younger population. This result nicely highlights the joint importance of lifecycle considerations together with experience and skills in allowing individuals to form new businesses in response to rapid changes in opportunities.

Finally, as we did for age, we compare the skill characteristics of those young individuals who

[22]To ensure correct inference on the heterogeneity, we re-estimate our main specification by interacting the shock with the characteristics capturing individual skills and experience. The results are reported in the appendix Table A.6, where we find that the differences across samples are indeed statistically significant.

start a firm in response to local demand shocks with the skill characteristics of the average young entrepreneur. The results are shown in Figure 5. We first note that the average young entrepreneur is, in fact, quite similar to the average young individual in the population in terms of skill. While the average young entrepreneur is slightly more educated, she has similar levels of general business, communication, and managerial skills as the average individual in the population, as measured by working in cognitive non-routine occupations, and only slightly more experience.

In contrast, all of these traits are significantly more pronounced among those entrepreneurs who specifically create new firms in response to the local demand shocks. For example, while only 18% of all entrepreneurs in the population worked previously in occupations that we classify as non-routine cognitive, strikingly, almost 50% of the responsive entrepreneurs have done so. Similar findings apply to individual experience. We find that almost 80% of the responsive entrepreneurs have more experience than the median. In contrast, among all entrepreneurs in the population, this applies to only 62% of individuals.

In summary, within the young population, responsive entrepreneurs are more likely to be experienced, educated, and to have general business and managerial skills developed through working in occupations specifically requiring those capabilities. However, skill in itself is not sufficient to enhance individuals' entrepreneurial responsiveness, as we find that among the older population, the more skilled individuals still remain unresponsive. Again, this finding highlights the joint importance of age and lifecycle considerations, in addition to experience and skills, as important determinants of an individual's ability and willingness to become an entrepreneur in response to exogenous economic shocks.

C. Robustness and Additional Results

Alternative Definitions of the Shock

As previously discussed for the municipality-level analysis, our results are strongly robust to alternative treatment definitions. In Table A.8, we further explore the individual responsiveness to both positive and negative, as well as continuous shocks. In specification 1 and 2, we show that individual responsiveness of the young is significantly higher both when using the continuous definition of the shock and when using shocks defined as being in the top 25th percentile within a municipality. The results are robust to the addition of the same set of controls (including the municipality by year fixed effects) as in the main specification of Table 5. In specifications 3 and 4, we show that the likelihood of becoming an entrepreneur is lower (though not always statistically significant) when the treatment is negative, defined as the bottom 10th or 25th percentile change in the price distribution in year t within a municipality. Interestingly, when we interact the negative treatment effect with age, we find that the young are less likely to start new businesses when economic conditions decline. These results illustrate that young individuals are particularly responsive to changes in local opportunities, both when such opportunities arise and when they decline.

Attrition due to Early Formation of Businesses

One additional consideration with respect to the interpretation of the results is the issue of attrition. It might be the case that the results are mechanically driven by compositional changes in the set of potential entrepreneurs that occur over time. For example, older individuals may be less likely to start a business because they already operate a business they started when they were younger. Older individuals would therefore appear to be less responsive to exogenous local opportunities, but the finding would simply reflect the fact they many of them had already responded to previous opportunities.

To explore whether this can explain our findings, we re-define the dependent variable $Founder$, as $FounderPre$, to be equal to 1000 in a given year if the individual has founded a firm in the past and that firm is still operating (0 otherwise). In that case, we consider individuals who already started businesses as if they always respond to local demand shocks. We do so to explore whether, under this most extreme case, we could reverse our findings. The results with this modified definition of the dependent variable are reported in Table A.9. We find that both the baseline findings on individual firm creation and the strong responsiveness of young individuals remain unchanged even when we apply this modified version of an entrepreneur. Therefore, such a mechanical explanation seems unlikely to drive our findings.

VII. Discussion and Additional Implications

Our results so far indicate that within a municipality, the individuals driving the firm creation response are both young and skilled. In this section, we discuss some additional considerations related to these individual-level findings, including the impacts of local municipal characteristics, the role of the informal sector in the economy's entrepreneurial response, and finally the potential implications of aging demographics.

A. *Local Characteristics and the Entrepreneurial Response*

The concentration of responsive entrepreneurs within the segment of young and skilled in the population suggests that the demographic characteristics of local economies may have important implications for their entrepreneurial responsiveness. In this section we discuss two different theories that may affect the responsiveness of young individuals in the economy. Specifically, we explore the importance of local financing constraints and the local stock of human capital. In both cases, we provide evidence consistent with these theories using individual level analysis that compares individuals' entrepreneurial responsiveness across different municipalities

To do so, we estimate the baseline individual specification, which we augment with an interaction term that aims to capture the specific characteristic of interest of the local economy. The specification is the following:

$$T_{ijt} = \alpha_j + \delta_t + \beta_0 \cdot Z_{jt} + \beta_2 \cdot Z_{jt} \cdot K_j + \varepsilon_{ijt} \tag{5}$$

where everything is as in equation 4, while K_j is an indicator equal to 1 if municipality j is in the upper $50th$ percentile (i.e. above median) of the distribution of a specific characteristic of interest. All these municipality level measures to construct K_j are based on data that are fixed at the beginning of the sample, to alleviate reverse causality concerns of the interaction term.[23] We study three specific measures, as discussed in more details below. We proxy for local access to finance using the total number of unique bank institutions per capita (so as to account for scale effects).[24] We then proxy for the local stock of human capital using the average education levels (in years) in the population. Finally, we proxy for entrepreneurial knowledge using the number of founders per capita. In Table 7 we report the results of this estimation without additional controls (columns 1, 3, and 5), as well as adding individual level controls (columns 2, 4, and 6).[25]

A.1. *Local Financing Constraints*

The ability to create new firms in response to new economic opportunities may hinge on access to finance (Evans and Jovanovic (1989); Hurst and Lusardi (2004)). Wealth required to satisfy downpayment or collateral demands would likely be needed to form a new business. Given that

[23]Data on education and founders come from RAIS, and are therefore based on the 1998 distribution, while the dataset on banks start in 2002.

[24]Data on the location of all banks across Brazil come from the Brazilian Central Bank.

[25]The set of controls includes all controls of column 4 of Table 5.

young individuals have less time to accumulate wealth, they may be more financially constrained, and we therefore posit that in municipalities with better access to finance the young should be even more responsive to local demand shocks.

Our results in Table 7 (columns 1 and 2) confirm this hypothesis. We find that young individuals are disproportionally more likely to start a new firm in areas with above median access to finance, as defined by the number of unique banks in the municipality. These results are consistent with the interpretation that local availability to finance enhances the ability of young individuals, who are more responsive but more likely to be financially constrained, to start a new business and take advantage of local opportunities.

A.2. Local Human Capital

Given the importance of skill in explaining individuals' entrepreneurial responsiveness, we hypothesize that local knowledge spillovers and the local stock of human capital might impact the ability of individual entrepreneurs to start new companies. Such human capital externalities have been documented in a number of different settings (Acemoglu and Angrist (2000); Iranzo and Peri (2009); Moretti (2004); Rauch (1993)). Gennaioli et al. (2012) formalize this logic in the context of entrepreneurship using what they call a Lucas-Lucas model, combining the Lucas (1978) model of entrepreneurship with the Lucas (1988) model of human capital externalities. Using regional data from 100 countries, they provide evidence that human capital externalities are essential in accounting for regional differences in development.

In our setting, given the potential importance of local knowledge spillovers and associated human capital externalities, we would expect young individuals to be more responsive in municipalities with a greater stock of educated and entrepreneurial individuals. We proxy for these characteristics using the average education of the workforce and the intensity of entrepreneurial activity, as defined earlier. Using either measure, in columns 3 and 5 of Table 7 we find an enhanced responsiveness of young individuals in municipalities with a high level of human capital, consistent with the theories. Importantly, we find that these results hold also when controlling for individual characteristics. That is, columns 4 and 6 show that individuals with similar levels of skill, measured by education and characteristics of past occupations, respond more strongly in municipalities with a greater concentration of human capital.

B. The Informal Sector

In the analysis and discussion up until this point, we have focused exclusively on firm creation responses in the formal sector, and shown that these new formal firms are founded primarily by young and skilled individuals. Brazil, however, also has large levels of informality (Ulyssea (2018)). This raises the question of whether the informal sector is also important in driving the entrepreneurial response to new local economic opportunities.

Addressing this issue is naturally challenging due to the obvious challenges of measuring informality. For example, our primary dataset RAIS only covers the universe of Brazilian formal sector firms. To address this issue, we utilize an alternative data source, namely the Brazilian National Household survey (PNAD), which is an annual survey representative at the national level. This survey aims to capture various labor market statistics and, importantly, contains information on both formal and informal firms and workers. As a result, the survey allows us to to study the responsiveness to local commodity price shocks of both the formal and informal sector. Since the survey is at the state-level, counts of formal and informal employers and employees are assigned to municipalities based on population shares in the state.[26]

Table 8 reports the elasticity of the number of formal and informal firms and employees in response to the local demand shock. In column 1 we find that the number of firms in the formal sector is highly responsive to local demand shocks, with an elasticity equal to 7.3%. The effect is highly statistically significant. In contrast, in column 2, when we explore how the number of firms in the informal sector change in response to local demand shocks, we find that the coefficient is statistically insignificant and of extremely small magnitude, equal to -0.1%. In columns 3 and 4 we explore the elasticity of number of workers (including self-employed) with respect to the local demand shock. Again, we find a highly statistically significant elasticity in the formal sector equal to 4.4%. In contrast, we find no response in the informal sector, with the elasticity statistically insignificant and close to zero.

These results show that in response to a positive local commodity shock, there is a significant firm entry response in the formal sector driven by young, educated, and skilled individuals, with essentially no response in the informal sector. These findings are consistent with the studies of La Porta and Shleifer (2008) and La Porta and Shleifer (2014). Using data from World Bank

[26]This assumption may impose measurement error that may lead to a downward bias of our estimated elasticities. As long as the bias similarly affect the formal and informal samples, it will allows us to explore the relative importance of the two sectors to firm creation in response to the local income shocks.

surveys, these studies show that that formal sector firms in developing economies tend to be run by highly skilled and highly educated entrepreneurs/managers. Informal sector firms tend to be small, do not grow, and are considerably less productive than formal sector firms, even when controlling for size. Formal sector firms also bring to bear a more varied business skill set; for instance, firms in the formal sector make greater use of capital and external finance and engage in marketing.

They argue their results support a dual view of developing economies, in which the informal sector firms arise primarily out of poverty, while economic growth and dynamism comes from a formal sector comprised of productive firms run by skilled, highly educated entrepreneurs. This is exactly what our evidence suggests. When new economic opportunities arise due to increases in local demand, it is precisely the young, educated entreprenurs in the formal sector with the requisite business managerial skillsets who seem to take advantage of them.

C. Demographic Change

Finally, we consider some potential implications of our findings with respect to demographic changes. One of the most profound demographic transitions of the past 50 years has been towards aging populations. This trend is widespread, stemming from both declines in fertility rates and increased longevity. Of all developed countries, the only one with a replacement level fertility rate is the United States. Japan has the lowest fertility rate of all developed countries at 1.3 children per household. Such striking demographic changes could have significant implications for the entrepreneurial responsiveness of these economies going forward.

Indeed, given our previous findings that the firm creation response is almost entirely concentrated among the young, an older population may directly lead to less firm entry in response to new economic opportunities. As emphasized by the model in Section II, in an older population there would be fewer individuals with sufficiently low non-pecuniary costs so as to find it worthwhile to switch from paid employment to entrepreneurship due to the shock. As we have discussed, such differences in non-pecuniary costs could be driven by a variety of lifecycle considerations, such as increased family obligations, looming retirement, or less flexibility in general.

Our results emphasize, however, that age alone is not sufficient to account for the firm creation response. Responsive entrepreneurs are also skilled. Given the importance of skill, aging populations may impose additional indirect equilibrium effects on the entrepreneurial responsiveness of the economy. For example, in older populations there may be fewer entrepreneurs, and therefore they may generate weaker human capital externalities (Gennaioli et al. (2012)), thus further reducing the economy's entrepreneurial responsiveness when opportunities arise.

Another possible equilibrium interaction between age and skills is suggested by Liang et al. (2014). They argue that, in older populations, young individuals might have a more difficult time moving up the job ladder into more generalist and managerial positions. That is, moving into senior positions takes longer in older populations. We have shown evidence that on-the-job training and the skills acquired in such higher-level positions are important for the ability to take advantage of new entrepreneurial opportunities. Thus, in older populations, where acquiring entrepreneurial skills may be more difficult, the entrepreneurial responsiveness of the economy may be even more limited. We find correlations consistent with this theory in our Brazilian micro data.[27]

VIII. Conclusion

In this paper we examine the characteristics of the individuals who become entrepreneurs when local opportunities arise due to an increase in local demand. We use Brazil as our setting, which allows us to analyze rich individual-level longitudinal data for the entire formal sector. We identify plausibly exogenous shocks to local demand by interacting municipality level historical production endowments of agricultural crops with contemporaneous changes in global commodity prices. These shocks lead to higher local employment and local income, and increased firm entry in the non-tradable sector.

In our main analysis, we explore the demographic and career characteristics of the individuals leading to the local entrepreneurial response and the creation of new firms. At the individual level, we find that the entrepreneurial response is almost entirely concentrated among the young, consistent with the idea that early in the lifecycle individuals have greater flexibility or risk tolerance, thus allowing them to engage in entrepreneurship in response to new local economic opportunities. However, age alone is insufficient to explain the firm creation response. The most responsive individuals are not only young, but those who also have significant prior industry experience and who have acquired relevant skills through previous engagement in occupations involving non-routine cognitive tasks.

When exploring individual heterogeneity across municipalities, we find that the entrepreneurial response of the young is larger in municipalities with better access to finance, and when more skilled

[27] In particular, controlling for year fixed effects, we find that a one standard deviation decrease in the average age of the municipality increases by 0.16 standard deviations the share of individuals with experience in non-routine cognitive occupations.

human capital is widely available. These results are consistent with the predictions of theories highlighting the role of local financing constraints, and local knowledge spillovers, which benefit the local young and skilled individuals. These results further emphasize how the characteristics of the local population can have a significant impact on the entrepreneurial responsiveness of the economy.

Finally, we illustrate that the entrepreneurial responsiveness of the economy is driven entirely by the formal sector. Using a large-scale annual survey we find no evidence for entrepreneurial responsiveness within the informal sector, consistent with the arguments of La Porta and Shleifer (2008) and La Porta and Shleifer (2014). We conclude with a broad discussion of the potential implications of our findings for how ongoing widespread demographic changes towards aging populations may impact entrepreneurial responsiveness and economic dynamism.

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Figure 1
Spatial Distribution of Commodities

The map shows the cross sectional variation in the value of crop production relative to the GDP at the municipality level. Darker shades of blue indicate municipalities where crops are more relevant, according to a split by quintiles of the empirical distribution in 2000.

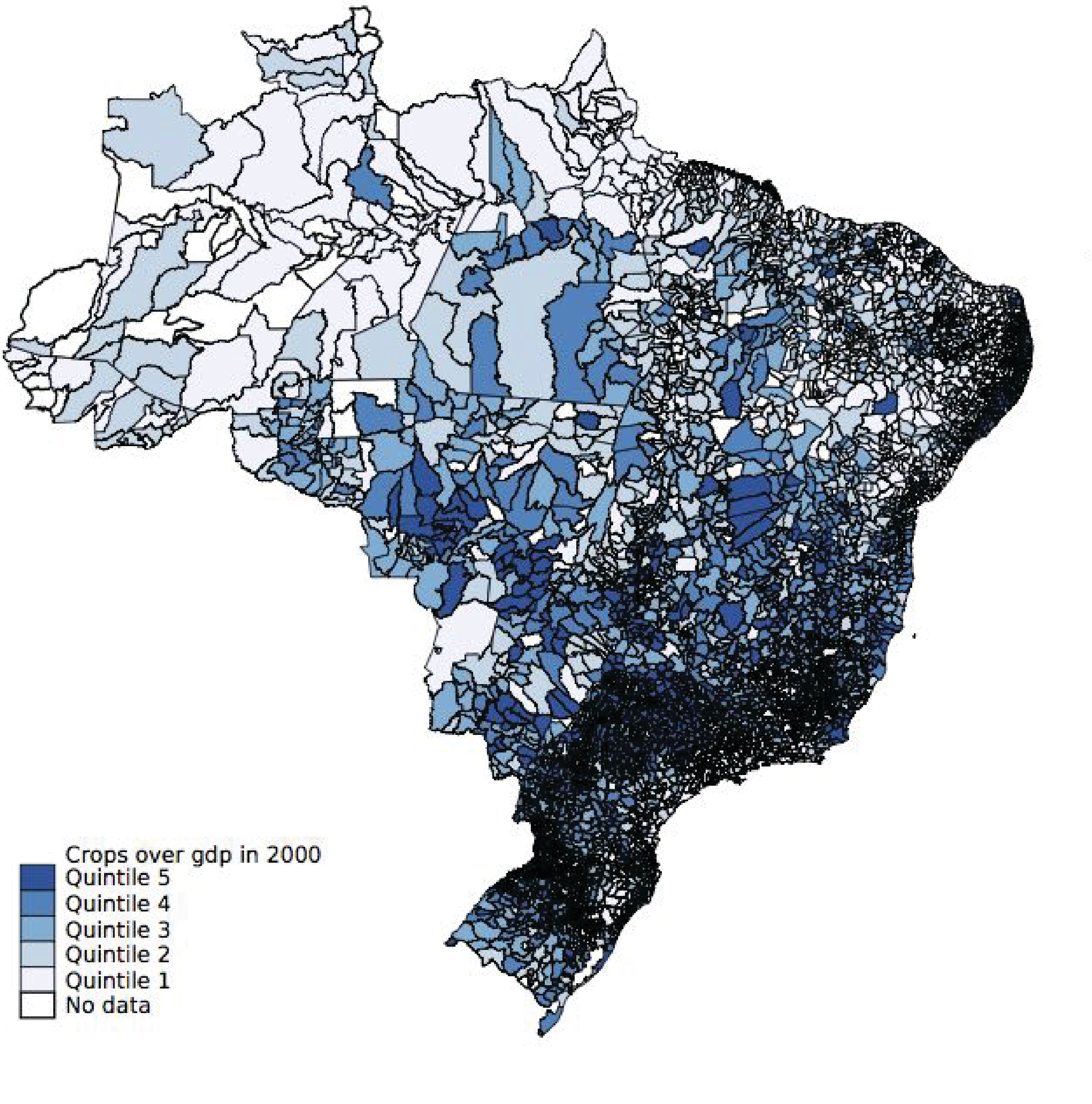

Figure 2
Residualized Crops Index

The graph captures the variation in the residuals $\hat{u}_{jt}$, estimated from equation 2 in the paper. We plot these regression residuals (thin gray lines) for a 10% random sample of all the municipalities in our sample over 1998-2014. The solid lines indicate the median, while the dashed lines indicate the tenth and ninetieth percentiles of the empirical distribution.

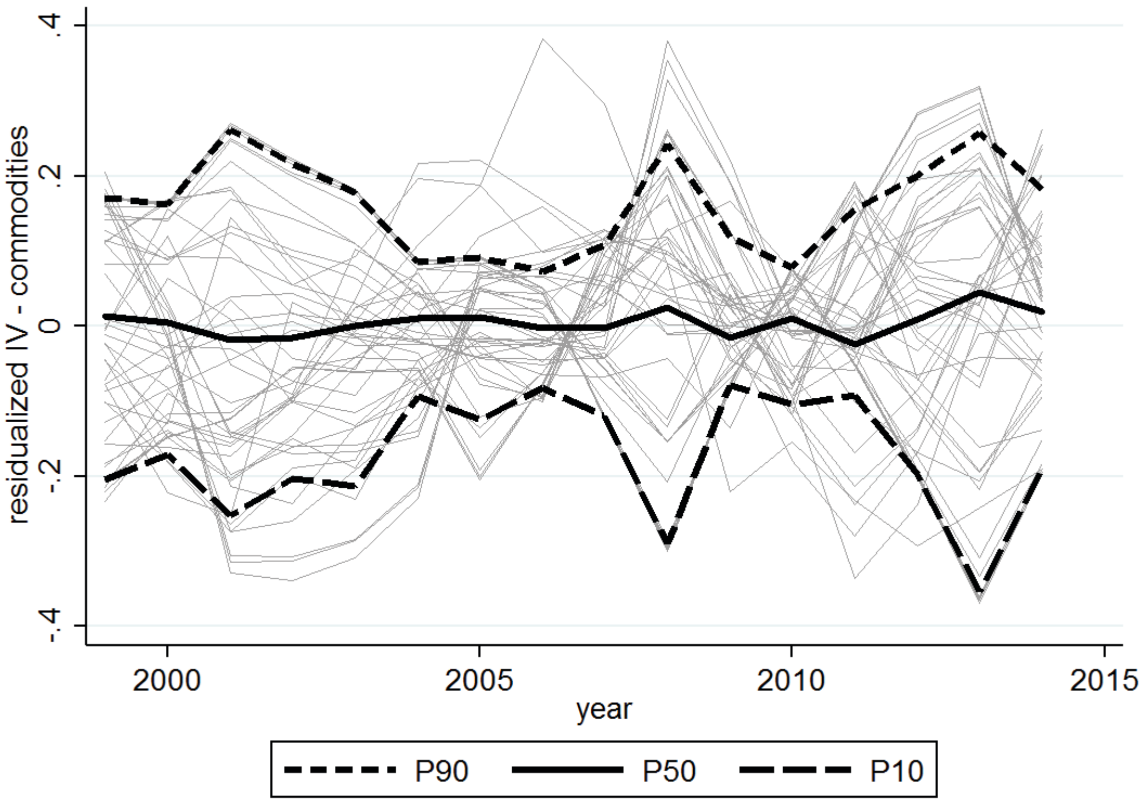

Figure 3
Entrepreneurial Response by Age Group

The coefficients reported in the graphs are estimates of β_n from the model $T_{injt} = \alpha_{nj} + \delta_{nt} + \beta_n \cdot Z_{jt} + \varepsilon_{injt}$, estimated on different age quartiles n. An observation in the model is an individual i, in age quartile n, municipality j, and year t. T_{injt} is an indicator for being a new entrepreneur. Z_{jt} is the commodity shock. Age quartiles are computed within the 10% analysis sample. The standard deviation bands are obtained from standard erros clustered at the municipality level. The magnitudes of the coefficients are in per-thousand points.

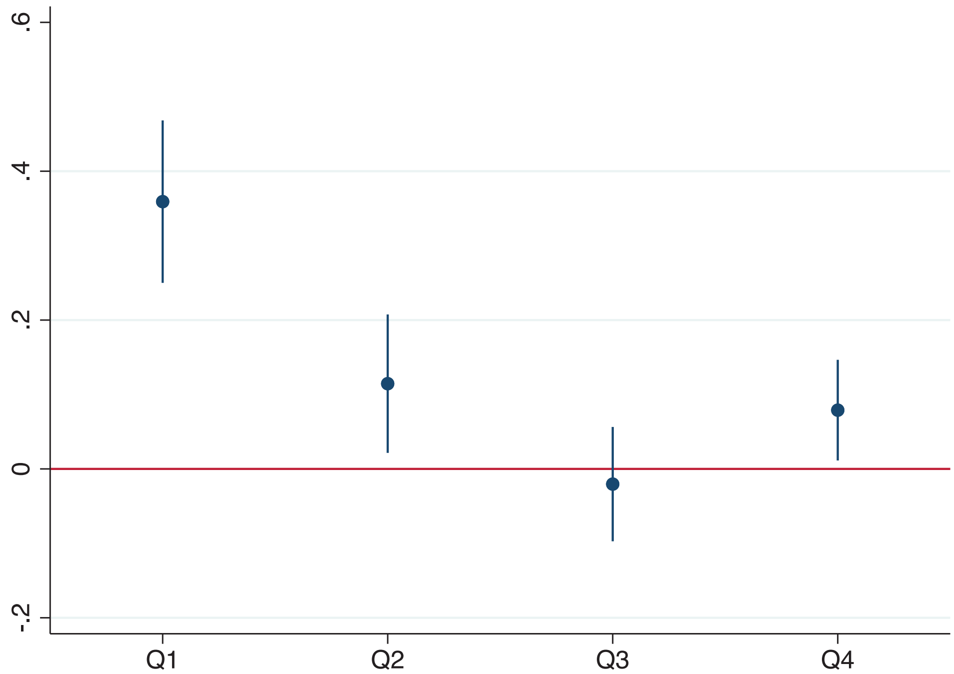

Figure 4
Comparison of Age Distribution

The graph reports the probability of being in each of the four different quartiles of the age distribution for individuals in the group of all workers (blue - population), in the group individuals who start a new firm in a given year (red - entrepreneurs), and individuals in the group of entrepreneurs who start a firm in response to the commodity shock (green - responsive entrepreneurs). The age quartiles are computed within the 10% analysis sample. The probabilities for the whole population are 0.25 by construction. The probabilities for the group of new entrepreneurs are computed from the data as the share of new entrepreneurs in each age quartile. The probabilities for the group of responsive entrepreneurs are obtained starting from estimates of β_n from the model $T_{injt} = \alpha_{nj} + \delta_{nt} + \beta_n \cdot Z_{jt} + \varepsilon_{injt}$ estimated on the sample of individuals belonging to the $n-th$ age quartile (for $n \in \{1, 2, 3, 4\}$). An observation in the model is an individual i, in subsample n, municipality j, and year t. T_{injt} is an indicator for being a new entrepreneur, α and δ are municipality and time fixed effects, Z_{jt} is the commodity shock. Each probability is then computed as the ratio β_n/β (where β is the coefficient from the model above estimated on the whole population) multiplied by 0.25 (the probability of being in each quartile). More details are discussed in Section A.2.

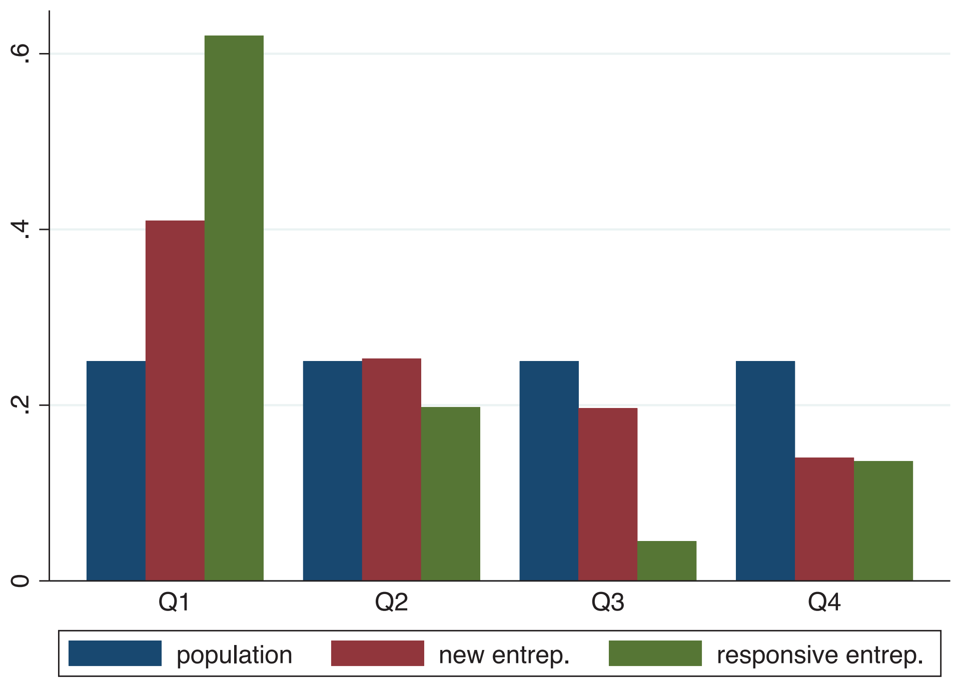

Figure 5
Comparison of Skill Distribution

The graph reports the conditional probability of having the characteristics reported on the y-axis, as discussed in the paper, for individuals in the group of all workers (blue - population), in the group individuals who start a new firm in a given year (red - entrepreneurs), and individuals in the group of entrepreneurs who start a firm in response to the commodity shock (green - responsive entrepreneurs). We focus on the set of "young" individuals only, i.e. in the bottom quartile of the age distribution in the analysis sample. The conditional probabilities are constructed analogously to Figure 4, and as discussed in Section A.2.

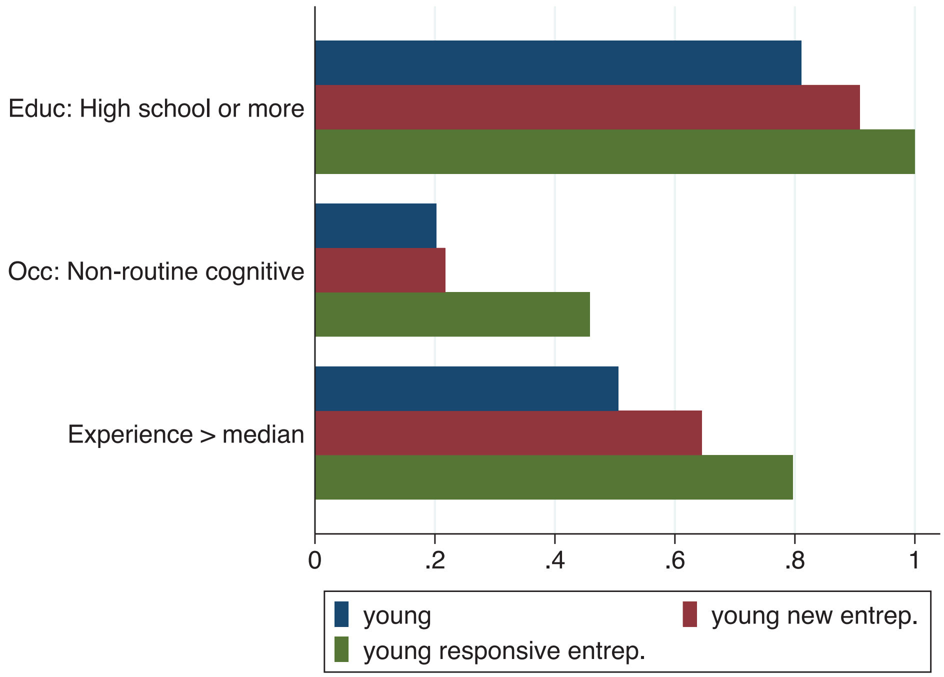

Table 1
Summary Statistics

This table reports summary statistics on the main analysis samples, as described in Section III. All averages from RAIS therefore refer to the period 1998-2014. Panel A describes the importance (as shares of firms, employees, and new firms) of each sector in the economy. Panel B describes municipality level data. Panel C describes describes individual level characteristics for all workers and founders, respectively.

A: Industry Composition - Annual Data (Shares)

	Firms	Employees	New Firms
Agirculture/Mining	0.068	0.095	0.034
Manufacturing	0.130	0.235	0.116
Non-tradable	0.489	0.248	0.554
Transp./Utilities/Commodities	0.050	0.050	0.055
Services	0.263	0.372	0.242

B: Municipality Composition - Annual Data

	Obs.	Mean	SD	Median
RAIS				
# Firms	82,463	274.9	761.1	64
# Employees	82,463	4214.5	13197.1	850
# New Firms	82,463	33.5	91.7	7
Other Data Sources				
Population	82,463	23680.8	45180.7	10676
GDP per capita (2000 US)	82,463	3093.8	3764.037	2217.473
Value of Commodities / GDP	5,443	1.2	3.7	0.156
Value of Commodities / Population	5,443	3038.7	10782.5	254.9

C: Individuals - Annual Data

	All		Founders	
	Obs.	Mean	Obs.	Mean
Founders of new firm (every 1000)	23,838,803	2.91	69,351	1000
Males	23,838,803	61%	69,351	57%
Age	23,838,803	35.6	69,351	31.9
Blue collar worker	23,838,803	48%	69,351	40%
White collar worker	23,838,803	42%	69,351	50%
Manager	23,838,803	4%	69,351	4%
Education dummy: less than High School	23,838,803	32%	69,351	17%
Education dummy: High School	23,838,803	47%	69,351	64%
Education dummy: more than High School	23,838,803	21%	69,351	19%

Table 2
Aggregate Results

This table reports the estimated effect of commodity price shocks on several municipality-level outcomes. The analysis sample covers the period 1998-2014 and its construction is described in Section III. The empirical specification is $Y_{jt} = \alpha_j + \delta_t + \beta Z_{jt} + \gamma X_{jt} + u_{jt}$, as described in Section V. *Total Employment* is the total number of employees, *Total Income* is the sum of payroll across all firms, *Number of Firms* is the total number of firms, and *Number of Closures* is the total number of firms that exit. All dependent variables are in logs. Z_{jt} is the top 10% local shock indicator generated from the crops index, as described in Section IV. All specifications include controls for log-population, year dummies and municipality fixed effects. Standard errors are clustered by municipality. *,**, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)
	Total Employment	Total Income	Number Firms	Number Closures
Treatment	0.069***	0.078***	0.045***	-0.008
	(0.007)	(0.008)	(0.004)	(0.007)
Year FE	Yes	Yes	Yes	Yes
Municipality FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Observations	80,903	80,903	80,903	66,152
Municipalities	5,443	5,443	5,443	5,420

Table 3
Aggregate Results by Sector

This table reports the estimated effect of commodity price shocks on several municipality-level outcomes across the four main sectors of the economy. The analysis sample covers the period 1998-2014 and its construction is described in Section III. The empirical specification is $Y_{jt} = \alpha_j + \delta_t + \beta Z_{jt} + \gamma X_{jt} + u_{jt}$, as described in Section V. *Total Employment* is the total number of employees, *Total Income* is the sum of payroll across all firms, *Number of Firms* is the total number of firms, and *Number of Closures* is the total number of firms that exit. All dependent variables are in logs. Z_{jt} is the top 10% local shock indicator generated from the crops index, as described in Section IV. All specifications include controls for log-population, year dummies and municipality fixed effects. Standard errors are clustered by municipality. *,**, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

Panel A: By Sector - Employment

	(1)	(2)	(3)	(4)
	Agriculture / Mining	Manufacturing	Non-tradable	Services
Treatment	0.116***	0.023*	0.049***	0.057***
	(0.012)	(0.013)	(0.009)	(0.008)
Year FE	Yes	Yes	Yes	Yes
Municipality FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Observations	71,980	66,293	77,971	80,347
Municipalities	5,161	5,086	5,435	5,443

Panel B: By Sector - Number of Firms

	(1)	(2)	(3)	(4)
	Agriculture / Mining	Manufacturing	Non-tradable	Services
Treatment	0.018***	0.007	0.058***	0.006
	(0.007)	(0.006)	(0.006)	(0.005)
Year FE	Yes	Yes	Yes	Yes
Municipality FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Observations	71,899	66,243	77,962	80,344
Municipalities	5,161	5,084	5,435	5,443

Table 4

New Firms - Ex-Post Outcomes

This table reports the estimated effects of commodity price shocks on the survival probability of newly created firms. The analysis sample covers the period 1998-2014 and its construction is described in Section III. The empirical specification is $S_{fjt} = \alpha_j + \delta_t + \beta Z_{jt} + u_{fjt}$. The dependent variable is a variable that equals 1,000 if the new firm survived more than 1, 2, 3 or 5 years, respectively, and takes value 0 otherwise. Z_{jt} is the top 10% local shock indicator generated from the crops index, as described in Section IV. All specifications include controls for year of entry dummies and municipality fixed effects, and f indicates a firm. Standard errors are clustered by municipality. *,**, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)
	$Survive \geq 1$	$Survive \geq 2$	$Survive \geq 3$	$Survive \geq 5$
Treatment	-.608	3.02**	5.9***	4.81***
	(1.28)	(1.36)	(1.73)	(1.69)
Year FE	Yes	Yes	Yes	Yes
Municipality FE	Yes	Yes	Yes	Yes
Survived every 1000	837	708	626	521
Observations	2,440,013	2,256,662	2,056,949	1,643,689
Municipalities	5,409	5,397	5,384	5,321

Table 5
Young Responsiveness

This table reports the estimated effect of commodity price shocks on the probability of becoming an entrepreneur. The analysis sample covers the period 1998-2014 and its construction is described in Section III. The basic empirical specification (column 1) is $T_{ijt} = \alpha_j + \delta_t + \beta \cdot Z_{jt} + \varepsilon_{ijt}$, as described in Section VI, and where Z_{jt} is the top 10% local shock indicator generated from the crops index, as described in Section IV. Columns 2, 3, 4, and 5 add different sets of fixed effects, and include an interaction term constructed as an indicator equal to 1 for individuals in the bottom quartile of the age distribution in the sample. In column 3, we add sector fixed effects, an indicator variable for whether the individual as a high school diploma, one for higher education, and an indicator variable for having a white collar occupation. In column 4, we also add a control for the rank of the individual within the wage distribution. The dependent variable, *Founder*, is an indicator equal to 1000 if the individual has founded a firm in year t, and 0 otherwise. Standard errors are clustered by municipality. *,**, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)
	Founder	Founder	Founder	Founder	Founder
Treatment	0.145***	0.032	0.037	0.053	
	(0.046)	(0.046)	(0.046)	(0.046)	
Treatment X Young		0.391***	0.380***	0.347***	0.242***
		(0.106)	(0.106)	(0.106)	(0.089)
Year	Y	Y	Y	Y	N
Municipality	Y	N	N	N	N
Municipality X Age Bottom Quart	N	Y	Y	Y	N
Municipality X Year	N	N	N	N	Y
Sector	N	Y	Y	Y	Y
Individual controls	N	N	Y	Y	Y
Wage at previous job	N	N	N	Y	Y
Observations (mil)	23.8	23.8	23.8	23.8	23.8

Table 6
Heterogeneity Within Municipalities

This table reports the estimated effect of commodity price shocks on the probability of becoming an entrepreneur, within the sample of individuals in the bottom quartile of the age distribution in the sample. The analysis sample covers the period 1998-2014 and its construction is described in Section III. We estimate the main individual level specification, namely $T_{ijt} = \alpha_j + \delta_t + \beta \cdot Z_{jt} + \varepsilon_{ijt}$, across various sample splits, with the aim of characteriing skilled versus unskilled individuals within the young population. The first two columns split the sample into individuals with high school or higher education (column 1) versus others (column 2). The second split is between individuals who engaged in non-routine cognitive occupations in $t-1$ (column 3) versus others (column 4). The third split is between individuals with above (column 5) or below years of within-firm experience in the $t-1$ and others (column 6). The dependent variable, *Founder*, is an indicator equal to 1000 in year t if the individual has founded a firm in year t, and 0 otherwise. Standard errors are clustered by municipality. *,**, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	Founder	Founder	Founder	Founder	Founder	Founder
Treatment	0.468***	-0.022	0.813***	0.242**	0.566***	0.147
	(0.126)	(0.154)	(0.234)	(0.112)	(0.168)	(0.115)
Partition	Education		Non-routine Cognitive		Experience	
Partition Criteria	>=HS	<HS	Yes	No	>median	<median
Year FE	Y	Y	Y	Y	Y	Y
Municipality FE	Y	Y	Y	Y	Y	Y
Observations (mil)	5.342	1.249	1.334	5.256	3.331	3.259

Table 7

Heterogeneity Across Municipalities

This table reports the estimated effect of commodity price shocks on the probability of becoming an entrepreneur, exploring heterogeneous effects across municipalities. We estimate the specification $T_{ijt} = \alpha_j + \delta_t + \beta_0 \cdot Z_{jt} + \beta_2 \cdot Z_{jt} \cdot K_j + \varepsilon_{ijt}$, where K_j is an indicator equal to 1 if municipality j is in the upper 50th percentile (i.e. above median) of the distribution of a specific characteristic of interest. All municipality level measures to construct K_j are based on data that are fixed at the beginning of the sample. Columns 1 and 2 split the sample by the total number of unique bank institutions per capita. Columns 3 and 4 split the sample by the average education levels (in years) in the population. Columns 5 and 6 split the sample by the number of founders per capita. Individual Controls include sector fixed effects, an indicator variable for whether the individual as a high school diploma, one for higher education, an indicator variable for having a white collar occupation, and a control for the rank of the individual within the wage distribution. Standard errors are clustered by municipality. *,**, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

	(1) Founder	(2) Founder	(3) Founder	(4) Founder	(5) Founder	(6) Founder
Treatment	0.190	0.199*	0.306	0.319***	0.062	0.042
	(0.117)	(0.115)	(0.109)	(0.108)	(0.177)	(0.175)
Treatment X PV	0.395**	0.398**	0.701**	0.664**	0.350*	0.380*
	(0.197)	(0.197)	(0.331)	(0.333)	(0.205)	(0.202)
Partition Variable (PV)	Banks	Banks	Education	Education	Founders	Founders
Year FE	Y	Y	Y	Y	Y	Y
Municipality FE	Y	Y	Y	Y	Y	Y
Individual Controls	N	Y	N	Y	N	Y
Observations (mil)	6.590	6.590	6.590	6.590	6.590	6.590

Table 8

Aggregate Results: Formal vs Informal Sector

This table reports the estimated effect of commodity price shocks on the number of formal and informal firms and workers in a given municipality. All the outcomes are obtained starting from PNAD data from 2009-2014, as discussed in the paper. State level counts of formal and informal firms/workers are assigned to municipalities based on population shares. The count of workers in column 3 and 4 include both employees and self-employed. All dependent variables are in logs. The Crops Index is the continuous log version defined in equation 2, so as to capture elasticities. All specifications include controls for log-population, year dummies and municipality fixed effects. Standard errors are clustered by municipality. *,**, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)
	Firms		All workers	
	Formal	Informal	Formal	Informal
Crop Index	0.073***	-0.001	0.040***	-0.001
	(0.009)	(0.004)	(0.003)	(0.003)
Year FE	Yes	Yes	Yes	Yes
Municipality FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Observations	21,726	21,726	21,726	21,726
Municipalities	5,435	5,435	5,435	5,435

Appendix

Shai Bernstein, Emanuele Colonnelli, Davide Malacrino, and Tim McQuade

A.1. Theoretical Model

To motivate our empirical analysis, we construct a two-period, three sector model of a local economy which combines the Lucas (1978) insights of entrepreneurial choice with a model of heterogeneous firms and firm entry. The model features exogenous profitability shocks to the local commodity sector in period 2. In the model, the local economy comprises three sectors, producing commodity goods, tradable goods, and local non-tradable goods, indexed respectively by $j \in \{C, T, N\}$. The commodity and tradable sectors provide a single homogenous good. The local non-tradable sector is comprised of a continuum of differentiated goods, indexed by varieties ω.

A. Individuals

All individuals in the local economy have Cobb-Douglas preferences over the tradable and non-tradable goods, given by the specification:

$$U = (1 - \alpha) \log C_{t,T} + \alpha \log C_{t,N},$$

where $C_{t,N}$ is a composite good given by the Dixit and Stiglitz (1977) CES aggregator

$$C_{t,N} = \left(\int_0^{M_t} c_{t,N} (\omega)^{\frac{\sigma-1}{\sigma}} d\omega \right)^{\frac{\sigma}{\sigma-1}},$$

*This is the substantially revised version of a paper previously titled "Marginal Entrepreneurs". Shai Bernstein is with Stanford University, Graduate School of Business, and NBER; Emanuele Colonnelli is with University of Chicago, Booth School of Business; Davide Malacrino is with the IMF, and Tim McQuade is with Stanford Graduate School of Business. The views expressed in this article/presentation are those of the authors and do not necessarily represent the views of the IMF, its Executive Board or IMF management. We are grateful to Nick Bloom, Giacomo De Giorgi, Rebecca Diamond, Florian Ederer, Callum Jones, Arvind Krishnamurthy, Ross Levine, Song Ma, Luigi Pistaferri, Josh Rauh, David Robinson, Amit Seru, Andrei Shleifer, Per Stromberg, as well as seminar participants at Alabama, Brigham Young, Columbia, Duke, EEA meetings, Fondazione Rodolfo DeBenedetti workshop, IFN, IMF, Statistics Norway, Stockholm School of Economics, Red Rock Finance conference and Stanford University. We are grateful to the Stanford Institute for Innovation in Developing Economies (SEED), the Private Enterprise Development in Low-Income Countries (PEDL) Initiative by the Centre for Economic Policy Research (CEPR), the Stanford Center for International Development (SCID), and the Abdul Latif Jameel Poverty Action Lab (J-PAL) Governance Initiative for financial support.

with $\sigma > 1$ and M_t equal to the equilibrium number of varieties produced in the non-tradable sector. The Cobb-Douglas upper tier implies each individual spends a fraction $1-\alpha$ of her total income on tradable goods and a fraction α of her total income on the non-tradable composite. Due to hometheticitiy of CES preferences, standard results then imply that the total demand for variety ω in the non-tradable sector is equal to:

$$C_{t,N}(\omega) = Y_t p_{t,N}(\omega)^{-\sigma} P_{t,N}^{\sigma-1},$$

where Y_t is aggregate local income, $p_{t,N}(\omega)$ is the price of variety ω, and $P_{t,N}$ is the aggregate price index:

$$P_{t,N} = \left(\int_0^{M_t} p_{t,N}(\omega)^{-(\sigma-1)} d\omega\right)^{\frac{-1}{\sigma-1}}$$

dual to the CES aggregator.

Each individual inelastically supplies one unit of labor. Paid employment in any of the sectors earns a wage w_t. We assume that labor is perfectly mobile within the overall economy, which means that we take the local wage $w_1 = w_2 = w$ as exogenous and constant through time.

We further assume, however, that entrepreneurs, i.e. those who create a business in the non-tradable sector, must come from the existing local population in an initial period 0, i.e. the existing local population at the beginning of the model's timeline. We denote the size of this existing population by L_0. A fraction φ of these individuals have a choice between entrepreneurship and paid employment along the lines of Lucas (1978). Thus, the size of the pool of potential entrepreneurs is φL_0.

These individuals can either provide a single unit of labor, earning the prevailing wage, or choose to become an entrepreneur in the non-tradable sector, producing a single differentiated variety ω, earning profits π_N. Each entrepreneur produces a single differentiated variety, so the total number of entrepreneurs is equal to the number of varieties produced M. Each individual i in the fraction φ of the initial local population capable of entrepreneurship faces a non-pecuniary fixed cost F_i associated with becoming an entrepreneur. These costs are heterogeneous among this population and we denote their distribution by $G(F)$.

As we discussed in the main text, we are essentially assuming that only the existing local population has sufficient local knowledge so as to be able to take advantage of new local economic opportunities when they arise. While this strikes us as a reasonable supposition and is indeed confirmed in the data, it is important to note that relaxing this assumption would not change the results or key implications of the model at all. However, doing so would complicate the model since it would involve formalizing the rest of the overall economy as a closed system.

B. *Production*

The commodity sector and tradable sector are perfectly competitive, each with a composite firm producing a homogeneous good. The prices of the commodity good and tradable good are set by global demand and are thus taken to be exogenous. We normalize the price of the tradable good $P_{t,T}$ to be equal to one and denote the commodity good price by $P_{t,C}$. The commodity sector hires $l_{t,C}$ unskilled workers at wage w and earns revenue $R_{t,C} = A_{t,C} l_{t,C}^{1-\gamma}$, where $0 < \gamma < 1$ and $A_{t,C} = \Omega_C P_{t,C}$ is the revenue productivity, equal to the physical productivity Ω_C times the price of the commodity good in period t. The tradable sector hires $l_{t,T}$ workers at wage w and earns revenue $R_{t,C} = A_{t,T} l_{t,T}^{1-\phi}$, where $\phi > 0$ and $A_{t,T} = \Omega_T P_{t,T}$. Profit maximization requires that the marginal revenue product of inputs be equal to the marginal cost of hiring that input

$$(1-\gamma)\, A_{t,C} l_{t,C}^{-\gamma} = w \tag{6}$$

$$(1-\phi)\, A_{t,T} l_{t,T}^{-\phi} = w \tag{7}$$

in each sector.

The non-tradable sector comprises a continuum of differentiated goods denoted by ω, produced by monopolistically competitive firms run by individual entrepreneurs. Following standard modeling devices in the heterogeneous firms literature, we assume that an individual entrepreneur operates the following CRS production technology:

$$q_{t,N}(\omega) = l_{t,N}(\omega)\,.$$

That is, one unit of labor produces one unit of differentiated product. Standard results on monopolistic competition imply that the price is equal to the usual constant markup over marginal cost.

$$p_{t,N}(\omega) = \frac{\sigma}{\sigma-1} w$$

For each variety ω, the quantity produced / labor employed and entrepreneurial profits are:

$$l_{t,N}(\omega) = \alpha Y_t p_{t,N}(\omega)^{-\sigma} P_{t,N}^{\sigma-1}$$

$$\pi_{t,N}(\omega) = \sigma^{-1} \alpha Y_t \left(\frac{p_{t,N}(\omega)}{P_{t,N}}\right)^{1-\sigma},$$

where recall Y_t is aggregate local income. Note that each differentiated variety carries the same price. This implies that the total amount of differentiated product that consumers demand, and thus also total employment in the non-tradable sector, is equal to:

$$M_t l_{t,N} = \frac{\sigma-1}{\sigma}\frac{\alpha Y_t}{w}.$$

It further implies that each entrepreneur earns the same profits $\pi_{t,N} = \alpha Y_t / \sigma M_t$.

C. Equilibrium

In equilibrium, firms and individuals optimize and supply equals demand for skilled and unskilled labor. Aggregate income in the local economy equals[1]:

$$\begin{aligned} Y_t &= l_{t,C} w + l_{t,T} w + l_{t,N} w + M_t \pi_{t,N} \\ &= l_{t,C} w + l_{t,T} w + \alpha Y_t, \end{aligned}$$

which when solved simplifies to:

$$Y_t = \frac{(l_{t,C} + l_{t,T})\, w}{1-\alpha} \tag{8}$$

Finally, the marginal entrepreneur must be indifferent between entrepreneurship and skilled labor. This pins down the cutoff non-pecuniary fixed cost:

$$\pi_{t,N} - F_t^{*} = w. \tag{9}$$

[1] We assume that the local population does not share in the profits of the commodity or tradable sectors

All individuals in the population φL_0 with $F_i < F_t^*$ will find it strictly optimal to work as an entrepreneur. The total number of entrepreneurs is therefore:

$$M_t = \varphi L_0 G\left(F_t^*\right) \tag{10}$$

Recall that labor is freely mobile, i.e. labor supply is perfectly elastic, so that $l_{t,T}$ and $l_{t,C}$ are functions of the exogenous wage w. Equilibrium thus involves solving, in each period t, for the labor employed in the commodity and tradable sectors, aggregate income Y_t, and the equilibrium number of entrepreneurs M_t.

D. *Proofs*

We study the effects of an exogenous increase in the price $P_{t,C}$ of the commodity good in period 2. We are particularly interested in the effects of such an increase on employment and firm entry in the non-tradable sector.

D.1. Proof of Proposition 1

Suppose that the number of entrepreneurs in period 2 remained fixed at its initial level M_1. The higher price raises the revenue productivity of the commodity sector $A_{2,C}$ in period 2. In the absence of labor mobility, this would raise wages. However, since workers are perfectly mobile, the increased revenue productivity leads to in-migration of workers until the marginal revenue productivity of the commodity sector is again equal to the exogenous wage w. Also due to perfect mobility, and since there is no change in the revenue productivity of the tradable sector, the amount of labor employed by the tradable sector remains the same in period 2 as in period 1. This implies that there is an increase in the total number of workers employed by the commodity and tradable sectors, which raises aggregate income Y, which then in turn increases the demand for non-tradable goods. Since demand is homothetic and marginal costs, i.e. local wages, are unchanged, the price of non-tradable goods does not change. Therefore, there is increased output and higher employment in the non-tradable sector. Under the assumption that the number of entrepreneurs does not change, this would lead to higher entrepreneurial profits.

However, this would then imply that entrepreneurial profits are now higher than wages. If we now allow for the number of entrepreneurs to adjust, there must be firm entry, as long as $\varphi > 0$. Those in the fraction φ of the initial local population, and those with sufficiently low non-pecuniary costs will choose to become entrepreneurs, increasing the number of differentiated varieties and reducing entrepreneurial profits through greater competition. This will continue until the the marginal entrepreneur is again indifferent between entrepreneurship and labor. Due to perfect mobility, the amount of labor employed by the commodity and tradable sectors will remain at the same levels, pinned down by the exogenous wage.

Mathematically, from equations (6) and (7), it is clear that:

$$\frac{\partial l_{t,C}}{\partial P_{t,C}} > 0, \frac{\partial l_{t,T}}{\partial P_{t,C}} = 0.$$

From equation (8), we therefore know that $\partial Y_t / \partial P_{t,C} > 0$. Since the wages remain unchanged, the price of the non-tradable good remains unchanged between periods 1 and 2. Furthermore, since all agents spend a fraction $\alpha$of their income on non-tradable consumption, it follows that the increase in aggregate local income implies an increase in aggregate non-tradable employment. We also know from equation (10) that $\partial M_t / \partial F_t^* > 0$. The higher the non-pecuniary cutoff, the more entrepreneurs there are. Implicitly differentiating equation (9), we get:

$$\frac{\partial F_t^*}{\partial P_{t,C}} = \frac{-\frac{\partial \pi_{t,N}}{\partial Y_t}\frac{\partial Y_t}{\partial P_{t,C}}}{\frac{\partial \pi_{t,N}}{\partial M_t}\frac{\partial M_t}{\partial F_t^*} - 1}.$$

Since $\pi_{t,N} = \alpha Y_t/\sigma M_t$, it is clear that entrepreneurial profits are increasing in aggregate income and decreasing in the number of entrepreneurs. Therefore, both the numerator and the denominator in the expression above are negative. This implies that $\partial F_t^*/\partial P_{t,C} > 0$, which in turn implies that $\partial M_t/\partial P_{t,C} > 0$. Thus if $P_{2,C} > P_{1,C}$ we have $M_2 > M_1$,which completes the proof.

D.2. Proof of Proposition 2

First, due to perfect mobility, $l_{t,C}$ and $l_{t,N}$ are completely determined by the revenue productivities and the exogenous wage. Thus, by equation (8), it is clear that aggregate income is independent of the number of entrepreneurs M_t. Moreover, since the price of the non-tradable good is a constant markup over the constant wage, this further implies that aggregate non-tradable employment is also independent of M_t. The number of entrepreneurs only determines the per-entrepreneur level of employment/output. Thus, the increase in the number of entrepreneurs determines whether the increase in employment between periods 1 and 2 occurs on the extensive or intensive margin.

Suppose that for a given potential pool of entrepreneurs φL_0, the equilibrium cutoff in period 2 is F_2^*. Now suppose that the potential pool of entrepreneurs is smaller, with $\tilde{\varphi} < \varphi$. Note then that $\tilde{\varphi} L_0 G(F_2^*) < \varphi L_0 G(F_2^*)$, which in turn implies:

$$\frac{\alpha Y_2}{\sigma \tilde{\varphi} L_0 G(F_2^*)} > \frac{\alpha Y_2}{\sigma \varphi L_0 G(F_2^*)}.$$

In other words, F_2^* can no longer be the equilibrium cutoff, because at that cutoff the number of entrepreneurs would be smaller, which implies higher entrepreneurial profits. But then equation (9) could not hold. So $\tilde{F}_2^* > F_2^*$. But this implies $\tilde{\pi}_{2,N} > \pi_{2,N}$, which requires $\tilde{M}_2 < M_2$. That is, there is a smaller firm entry response between periods 1 and 2 if the potential pool of entrepreneurs is smaller. This completes the proof.

A.2. Estimating Entrepreneur Characteristics

In this section, we describe how to formally estimate the distributional charactersitcs of those entrepreneurs who start a firm in response to local demand shocks. This is be useful in comparing the characteristics of these entrepreneurs to the characterstics of the average entrepreneur in the Brazilian population, as discussed in Section VI.

As in the main text, let the binary indicator variable T_{ijt} denote the decision in year t of an individual i in municipality j to become an entrepreneur. We again let $Z_{jt} = 1$ denote a time of exogenous increase in local demand in municipality j, as proxied for by local agricultural endowment shocks. Let T_{1ijt} and T_{0ijt} denote the choice to become an entrepreneur when $Z_{jt} = 1$ and $Z_{jt} = 0$, respectively. Then we focus on the "responsive entrepreneurs", namely those individuals who start a business in response to the endowment shock; that is, an individual i for whom $T_{1ijt} = 1$ and $T_{0ijt} = 0$ or, equivalently, $T_{1ijt} > T_{0ijt}$. Our goal is to estimate the size and characteristics of this population.

Towards this end, we investigate heterogeneity in the entrepreneurial response to local demand shocks by sorting on individual characteristics. Specifically, let the variable n index demographic categories (e.g. quartiles) of a characteristic of interest such as age. We then estimate the following linear probability model for each subpopulation indexed by n, in particular for young individuals and then again for old individuals:

$$T_{injt} = \alpha_{nj} + \delta_{nt} + \beta_n \cdot Z_{jt} + \varepsilon_{injt}. \tag{11}$$

where α_{nj} denote municipality fixed effects and δ_{nt} denote time fixed effects. We allow each subpopulation to have its own baseline level of entrepreneurship and to have its own time trend.

Two assumptions are key to our empirical strategy. First, as long as Z_{jt} is uncorrelated with the error term, this specification provides a consistent estimate of β_n. Second, we assume monotonicity, which says that $T_{1ijt} \geq T_{0ijt}$ for all i. This rules out cases where an individual starts a business when economic opportunities are weak, but does not start a business when opportunities are strong.

The assumptions of orthogonality and monotonicity imply that:

$$\begin{aligned} P\left(T_{1injt} > T_{0injt}\right) &= E\left[T_{1injt} - T_{0injt}\right] \\ &= E\left[T_{injt} | Z_{jt} = 1\right] - E\left[T_{injt} | Z_{jt} = 0\right] \\ &= \beta_n. \end{aligned}$$

Within this framework, the treatment coefficient β_n reveals not only the increase in the probability to become an entrepreneur, but also the proportion of individuals in demographic category n who are responsive entrepreneurs.

Additionally, we would like to determine the distribution of characteristics *conditional* on being a responsive entrepreneur. This will allow us to compare their characteristics to the overall population of workers and to the overall set of entrepreneurs. We can accomplish this with Bayes's rule. Let X_i be the characteristic of interest. Then, conditional on an individual i being a responsive entrepreneur, the probability that i is in category n can be calculated as follows:

$$\frac{P\left(X_i = n | T_{1ijt} > T_{0ijt}\right)}{P\left(X_i = n\right)} = \frac{P\left(T_{1ijt} > T_{0ijt} | X_i = n\right)}{P\left(T_{1ijt} > T_{0ijt}\right)} = \frac{\beta_n}{\beta}$$

where β is found by estimating equation (11) on the entire population. This implies that the distribution of characteristics of responsive entrepreneurs is given by:

$$P\left(X_i = n | T_{1ijt} > T_{0ijt}\right) = \frac{\beta_n}{\beta} P\left(X_i = n\right).$$

The same statistics for all entrepreneurs in the population are computed directly from the data, as the fraction of individuals who create a new firm in a given year and that are in a particular age quartile.

Table A.1
Agricultural Endowments Across Municipalities

This table provides a break down of agricultural crops and the number of municipalities in which they are being produced. The table also provide information on average value of these crops in 2000. We started with 66 crops. We found prices fro 26 crops. Six of these (bean, broadbean, pea, rye, sunflower, triticale) were discarded as we were only able to find a price for generic "grains". Among the remaining 20, 3 different types of coffee are aggregated into the "Total coffee" category in the table below. Similarly two types of cotton are aggregated in a unique "total cotton" category. As a result from these aggregation we are left with the 17 types of crops listed below.

Crops	Total Municipalities	Total Value (USD Billions)
Sugarcanes	3529	204.38
Total Coffee	2030	9.87
Soybeans	1495	9.26
Maize	5003	3.67
Rice	4045	2.43
Cotton	1210	2.06
Tobaccos	973	2.05
Yerba mate	541	1.05
Cocoa	278	0.57
Wheat	815	0.32
Rubber	421	0.09
Sorghums	375	0.07
Indiantea	7	0.06
Orange	3763	0.05
Barley	183	0.03
Oatmeal	411	0.01
Banana	3870	0.01

Table A.2

Aggregate Results: Sources of Employment Creation

This table reports the estimated effect of commodity price shocks on several municipality-level outcomes, splitting across sources of employment creation. The analysis sample covers the period 1998-2014 and its construction is described in Section III. The empirical specification is $Y_{jt} = \alpha_j + \delta_t + \beta Z_{jt} + \gamma X_{jt} + u_{jt}$, as described in Section V. The dependent variable in column 1 is the total number of employees who were either unemployed or informal (i.e. who were not in the RAIS dataset) in $t-1$. The dependent variable in column 2 is the total number of employees who were working in a different municipality in $t-1$. The dependent variable in column 3 is the total number of employees who were working in the same municipality in $t-1$. All dependent variables are in logs. Z_{jt} is the top 10% local shock indicator generated from the crops index, as described in Section IV. All specifications include controls for log-population, year dummies and municipality fixed effects. Standard errors are clustered by municipality. *,**, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)
	Employment from:		
	Unemployment / Informality	Different municipaliy	Same municipality
Treatment	0.066***	0.068***	0.071***
	(0.009)	(0.010)	(0.008)
Year FE	Yes	Yes	Yes
Municipality FE	Yes	Yes	Yes
Controls	Yes	Yes	Yes
Observations	80,456	79,630	80,845
Municipalities	5,443	5,443	5,443

Table A.3

Aggregate Results: Dropping "World Producer" Municipalities

This table reports the estimated effect of commodity price shocks on several municipality-level outcomes, excluding municipalities who produce a large share of the world production of any crop. The analysis sample covers the period 1998-2014 and its construction is described in Section III. The empirical specification is $Y_{jt} = \alpha_j + \delta_t + \beta Z_{jt} + \gamma X_{jt} + u_{jt}$, as described in Section V. *Total Employment* is the total number of employees, *Total Income* is the sum of payroll across all firms, *Number of Firms* is the total number of firms, and *Number of Closures* is the total number of firms that exit. All dependent variables are in logs. Z_{jt} is the top 10% local shock indicator generated from the crops index, as described in Section IV. In Panel A (Panel B), the sample excludes municipalities that ever produced 1% (0.5%) or more of the world production of any commodity in any year in the period 1996-2015. All specifications include controls for log-population, year dummies and municipality fixed effects. Standard errors are clustered by municipality. *,**, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

Panel A - Dropping 1% World Producers

	(1)	(2)	(3)	(4)
	Total Employment	Total Income	Number Firms	Number Closures
Treatment	0.069***	0.078***	0.045***	-0.007
	(0.007)	(0.008)	(0.004)	(0.007)
Year FE	Yes	Yes	Yes	Yes
Municipality FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Observations	79,943	79,943	79,943	65,271
Municipalities	5,379	5,379	5,379	5,356

Panel B - Dropping 0.5% World Producers

	(1)	(2)	(3)	(4)
	Total Employment	Total Income	Number Firms	Number Closures
Treatment	0.069***	0.077***	0.045***	-0.006
	(0.007)	(0.008)	(0.004)	(0.007)
Year FE	Yes	Yes	Yes	Yes
Municipality FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Observations	78,404	78,404	78,404	63,821
Municipalities	5,276	5,276	5,276	5,253

Table A.4
Aggregate Results: Heterogeneity by Type of Shock

This table reports the estimated effect of commodity price shocks on several municipality-level outcomes, using different variations of the commodity shock, as defined in Section V.B. The analysis sample covers the period 1998-2014 and its construction is described in Section III. The empirical specification is $Y_{jt} = \alpha_j + \delta_t + \beta Z_{jt} + \gamma X_{jt} + u_{jt}$, as described in Section V, but where Z_{jt} is either in the top 10% (row 1), top 25% (row 2), bottom 10% (row 3), or bottom 25% (row 4). In row 5, Z_{jt} is the continuous version of the shock, as defined by equation 2. *Total Employment* is the total number of employees, *Total Income* is the sum of payroll across all firms, *Number of Firms* is the total number of firms, and *Number of Closures* is the total number of firms that exit. All dependent variables are in logs. All specifications include controls for log-population, year dummies and municipality fixed effects. Standard errors are clustered by municipality. *,**, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

	(1) Employment	(2) Total Income	(3) Number of Firms	(4) Firm Closures
Treatment - Top 10%	0.069***	0.078***	0.045***	-0.008
	(0.007)	(0.008)	(0.004)	(0.007)
Treatment - Top 25%	0.057***	0.063***	0.036***	-0.009*
	(0.006)	(0.006)	(0.003)	(0.005)
Treatment - Bottom 10%	-0.065***	-0.068***	-0.040***	0.004
	(0.008)	(0.009)	(0.004)	(0.007)
Treatment - Bottom 25%	-0.047***	-0.048***	-0.037***	-0.001
	(0.005)	(0.006)	(0.003)	(0.005)
Treatment - Continuous variable	0.206***	0.222***	0.143***	-0.009
	(0.020)	(0.021)	(0.011)	(0.017)

Table A.5

Aggregate Results: Persistence of the Shock

This table reports the estimated effect of commodity price shocks on several municipality-level outcomes, exploring how persistent the effects of the shocks are. The analysis sample covers the period 1998-2014 and its construction is described in Section III. The empirical specification is as described in Section V. *Total Employment* is the total number of employees, *Total Income* is the sum of payroll across all firms, *Number of Firms* is the total number of firms, and *Number of Closures* is the total number of firms that exit. All dependent variables are in logs. In column 1, the treatment is the top 10% local shock indicator generated from the crops index, as described in Section IV. Columns 2 to 5 indicate different variations of the main treatment variable, where the shock refers to 1, 2, 3, or 4 years before year t, respectively. Each row indicates a different dependent variable, and therefore each cell represents the coefficient of one single regression. All specifications include controls for log-population, year dummies and municipality fixed effects. Standard errors are clustered by municipality. *,**, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)
Lag treatment	0	1	2	3	4
Total employment	0.069***	0.066***	0.051***	0.041***	0.028***
	(0.007)	(0.007)	(0.006)	(0.006)	(0.005)
Total income	0.078***	0.068***	0.057***	0.049***	0.036***
	(0.008)	(0.008)	(0.007)	(0.007)	(0.006)
Total number of firms	0.045***	0.038***	0.030***	0.030***	0.021***
	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)
Number of closures	-0.008	0.000	-0.018**	-0.000	0.003
	(0.007)	(0.008)	(0.008)	(0.008)	(0.008)

Table A.6

Heterogeneity Within Municipality: Interactions

This table reports the estimated effects of commodity price shocks on the probability of becoming an entrepreneur, testing for heterogeneous treatment effects across individuals with different skills, within the set of yong individualas (i.e. in the bottom quartile of the age distribution). The empirical specification is $T_{ijt} = \alpha_j + \delta_t + \alpha_{jPV} + \delta_{tPV} + \beta_0 \cdot Z_{jt} + \beta_1 \cdot PV_{ijt} + \beta_2 Z_{jt} PV_{ijt} + \varepsilon_{ijt}$, where Z_{jt} is the top 10% local shock indicator generated from the crops index, as described in Section IV. PV_{ijt} is an indicator variable that characterizes an individual's skill. In column 1, $PV_{ijt} = 1$ if in $t-1$ the individual has at least a high school level of education. In column 2, $PV_{ijt} = 1$ if in $t-1$ the individual was working in an occupation that required cognitive non-routine skills. In column 3, $PV_{ijt} = 1$ if in $t-1$ the individual had above median within-firm level of experience. The dependent variable, *Founder*, is an indicator equal to 1000 if the individual has founded a firm in year t, and 0 otherwise. All specification includes fixed effects for year, municipality, year by partition variable, and municipality by partition variable. Standard errors are clustered by municipality. *,**, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)
	Founder	Founder	Founder
Treatment	-0.022	0.242**	0.147
	(0.153)	(0.112)	(0.115)
Treatment X Partition Variable (PV)	0.490**	0.571**	0.418**
	(0.196)	(0.249)	(0.197)
Partition Variable	Education	Non-Routine Cognitive	Experience
Year FE	Y	Y	Y
Municipality FE	Y	Y	Y
Year X PV FE	Y	Y	Y
Municipality X PV FE	Y	Y	Y
Baseline control for PV	Y	Y	Y
Observations	6,590,390	6,590,390	6,590,390

Table A.7
Heterogeneity Within Municipalities: Old

This table reports the estimated effect of commodity price shocks on the probability of becoming an entrepreneur, within the sample of individuals in the top three quartiles of the age distribution in the sample. The analysis sample covers the period 1998-2014 and its construction is described in Section III. We estimate the main individual level specification, namely $T_{ijt} = \alpha_j + \delta_t + \beta \cdot Z_{jt} + \varepsilon_{ijt}$, across various sample splits, with the aim of characteriing skilled versus unskilled individuals within the old population. The first two columns split the sample into individuals with high school or higher education (column 1) versus others (column 2). The second split is between individuals who engaged in non-routine cognitive occupations in $t-1$ (column 3) versus others (column 4). The third split is between individuals with above (column 5) or below years of within-firm experience in the $t-1$ and others (column 6). The dependent variable, *Founder*, is an indicator equal to 1000 in year t if the individual has founded a firm in year t, and 0 otherwise. Standard errors are clustered by municipality. *,**, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

	(3)	(4)	(1)	(2)	(5)	(6)
	Founder	Founder	Founder	Founder	Founder	Founder
Treatment	0.063	0.053	0.144	0.039	0.0232	0.096
	(0.063)	(0.055)	(0.110)	(0.049)	(0.067)	(0.061)
Partition	Education		Non-routine Cognitive		Experience	
Partition Criteria	>=HS	<HS	Yes	No	>median	<median
Year FE	Y	Y	Y	Y	Y	Y
Municipality FE	Y	Y	Y	Y	Y	Y
Observations (mil)	11.000	6.295	3.488	13.800	8.664	8.583

Table A.8

Young Responsiveness: Robusteness to Different Shock Definitions

This table reports the estimated effect of commodity price shocks on the probability of becoming an entrepreneur, using different variations of the commodity shock, as defined in Section VI.C. The analysis sample covers the period 1998-2014 and its construction is described in Section III. The basic empirical specification (column 1) is $T_{ijt} = \alpha_j + \delta_t + \beta \cdot Z_{jt} + \varepsilon_{ijt}$, as described in Section VI, but where Z_{jt} is either in the top 10% (specification 1), top 25% (specification 2), bottom 10% (specification 3), or bottom 25% (specification 4). In specification 5, Z_{jt} is the continuous version of the shock, as defined by equation 2. Columns 2, 3, 4, and 5 add different sets of fixed effects, and include an interaction term constructed as an indicator equal to 1 for individuals in the bottom quartile of the age distribution in the sample. In column 3, we add sector fixed effects, an indicator variable for whether the individual as a high school diploma, one for higher education, and an indicator variable for having a white collar occupation. In column 4, we also add a control for the rank of the individual within the wage distribution. The dependent variable, *Founder*, is an indicator equal to 1000 if the individual has founded a firm in year t, and 0 otherwise. Standard errors are clustered by municipality. *,**, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

		(1)	(2)	(3)	(4)	(5)
		Founder	Founder	Founder	Founder	Founder
Specification 1	Continuous Index	.251**	.239***	.248***	.278***	
		(.098)	(.090)	(.090)	(.091)	
	Continuous Index X Young		.0204***	.017***	.011***	.069***
			(.004)	(.004)	(.004)	(.009)
Specification 2	Top 25%	.066**	-.017	-.010	.007	
		(.032)	(.031)	(.031)	(.031)	
	Top 25% X Young		.301***	.283***	.247***	.196***
			(.069)	(.069)	(.069)	(.060)
Specification 3	Bottom 10%	-.093**	-.072*	-.070*	-.078*	
		(.042)	(.042)	(.042)	(.043)	
	Bottom 10% X Young		-.080	-.100	-.128	-.168**
			(.102)	(.103)	(.103)	(.084)
Specification 4	Bottom 25%	-.077***	-.0549*	-.053*	-.055*	
		(.029)	(.029)	(.029)	(.029)	
	Bottom 25% X Young		-.091	-.112*	-.140**	-.209***
			(.067)	(.067)	(.059)	(.059)
	Year	Y	Y	Y	N	N
	Municipality	Y	N	N	N	N
	Municipality X Age Bottom Quart	N	Y	Y	N	N
	Municipality X Year	N	N	N	Y	Y
	Sector	N	Y	Y	Y	Y
	Individual controls	N	N	Y	Y	Y
	Wage at previous job	N	N	N	Y	Y
	Observations (mil)	23.8	23.8	23.8	23.8	23.8

Table A.9

Young Responsiveness: Attrition

This table reports the estimated effect of commodity price shocks on the probability of becoming an entrepreneur, where we consider as vary the definition of entrepreneur to account for attrition. The analysis sample covers the period 1998-2014 and its construction is described in Section III. The basic empirical specification (column 1) is $T_{ijt} = \alpha_j + \delta_t + \beta \cdot Z_{jt} + \varepsilon_{ijt}$, as described in Section VI, and where Z_{jt} is the top 10% local shock indicator generated from the crops index, as described in Section IV. Columns 2, 3, 4, and 5 add different sets of fixed effects, and include an interaction term constructed as an indicator equal to 1 for individuals in the bottom quartile of the age distribution in the sample. In column 3, we add sector fixed effects, an indicator variable for whether the individual as a high school diploma, one for higher education, and an indicator variable for having a white collar occupation. In column 4, we also add a control for the rank of the individual within the wage distribution. The dependent variable, *FounderPre*, is a variable equal to 1000 in year t if the individual has founded a firm prior to year t and that firm is still alive in year t, and 0 otherwise. Standard errors are clustered by municipality. *,**, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

	(1) FounderPre	(2) FounderPre	(3) FounderPre	(4) FounderPre	(5) FounderPre
Treatment	0.126***	0.016	0.021	0.034	
	(0.044)	(0.044)	(0.044)	(0.045)	
Treatment X Young		0.380***	0.369***	0.341***	0.238***
		(0.101)	(0.101)	(.106)	(.085)
Year	Y	Y	Y	N	N
Municipality	Y	N	N	N	N
Municipality X Age Bottom Quart	N	Y	Y	N	N
Municipality X Year	N	N	N	Y	Y
Sector	N	Y	Y	Y	Y
Individual controls	N	N	Y	Y	Y
Wage at previous job	N	N	N	Y	Y
Observations (mil)	23.8	23.8	23.8	23.8	23.8