Who Creates New Firms When Local Opportunities Arise?

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ABSTRACT

We examine the characteristics of the individuals who become entrepreneurs when local opportunities arise. 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. Their response is larger in municipalities with better access to finance and more skilled human capital, and is driven entirely by the formal market. These results highlight how the composition of the local population can have a significant impact on the entrepreneurial responsiveness of the economy.

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1. Introduction

A growing theoretical and empirical literature shows that new business formation is key to understanding how economies respond to economic shocks. Adelino, Ma, and Robinson (2017) show that new firms generate the majority of jobs created in response to fluctuations in local demand driven by the manufacturing sector. Recent work using firm-level data corroborates these findings in different settings, for example, following oil and gas discoveries, and local cash windfalls (Decker et al. 2017; Bermejo et al. 2018). These empirical studies find a theoretical counterpart in numerous macroeconomic studies that emphasize how the response of new firms creation, through various channels, can amplify and propagate the impact of economic shocks.[1]

The magnitude of the firm entry response to economic shocks depends on the existence of individuals in the population who are capable of identifying new economic opportunities when they arise, and who are then willing and able to transition to entrepreneurship to exploit them. However, little is known about the characteristics of such "responsive" or "Kirznerian" entrepreneurs, those individuals who are alert to and act upon opportunities driven by changing market conditions (Kirzner (1973, 1985)).[2]

This issue is particularly salient. First, if these responsive individuals are concentrated in particular demographics or have certain specialized traits, then the composition of the local population may have significant implications for the entrepreneurial responsiveness and dynamism of the local economy. Second, when the economy is expanding following positive economic shocks, and more individuals are drawn to entrepreneurship, these "responsive entrepreneurs" may differ in meaningful and policy-relevant ways from other inframarginal entrepreneurs also operating in the economy. For instance, responding quickly to changing market conditions may require a degree of flexibility in one's personal circumstances not required by other forms of self-employment. Finally, understanding the key traits of such responsive individuals may be important to policymakers in thinking about how to nurture latent entrepreneurial potential and foster vibrant 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 local demand shocks. We document that not only are there meaningful differences between these responsive entrepreneurs and the average entrepreneur in the economy, but that there is indeed substantial heterogeneity in the firm entry response based on

[1] Clementi and Palazzo (2016) argue that, due to the lifecycle features of new entrants, firm entry strengthens the impact of economic shocks and makes their effects more persistent. In a similar vein, Sedlácek (2014) argues that the lack of new startups during a severe downturn can lead to persistent declines in the employment potential of the economy. Bilbiie et al. (2012) show that firm entry can increase product diversity, which in turn leads to the propagation of the effects of the initial shock. Chatterjee and Cooper (2014) and Devereux et al. (1996) share similar features. Jaimovich and Floetotto (2008) show how procyclical firm entry can lead to countercyclical variations in markups, leading to procyclical movements in TFP. Sedlacek et al. (2017) show that the presence of high-growth startups are key for TFP shocks to translate into aggregate and persistent gains.

[2] In contrast, a substantial literature attempts to characterize the overall entrepreneurial population in the economy. See, among others, Kihlstrom and Laffont (1979); Blanchflower and Oswald (1998); Hamilton (2000); Moskowitz and Vissing-Jorgensen (2002); Humphries (2016); Hvide and Oyer (2018); Kerr, Kerr, Xu et al. (2018).

personal characteristics. We further argue, through the lens of supporting empirical evidence, that this individual-level heterogeneity implies that specific features of the local economy, such as demographic composition, formality, availability of financing, and availability of skilled human capital, can have significant aggregate implications for the ability of the local economy to generate new entrepreneurial activity in response to changing market conditions.

The investigation of the characteristics of responsive entrepreneurs poses two challenges. First, it is crucial to have rich individual-level data that allow one to follow individuals over time and to identify *who* chooses to become an entrepreneur and *when*. Second, in order to study the entrepreneurial response of individuals to changes in economic opportunities, and mitigate concerns about reverse causality, we need to rely on plausibly exogenous and well-defined variation. To overcome these obstacles, we choose to study the Brazilian economy.

This setting allows us to use 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, 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.[3] Second, the large agribusiness sector in the Brazilian economy allows us to identify exogenous local demand shocks arising from global commodity price fluctuations, and to study the firm creation response.[4] 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 U.S. oil and gas booms. By focusing on individual entrepreneurial responsiveness to commodity price driven changes in the value of local agricultural endowments, our identification strategy simply requires that unobserved shocks to demographic-specific entrepreneurial opportunities at the local level cannot themselves drive fluctuations in global commodity prices. Since there are thousands of local municipalities in Brazil, such a scenario seems quite unlikely.[5]

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 (2003), and Chaney (2008). This framework is especially helpful for a number of reasons. First, it demonstrates conceptually and formally how our specific commodity price shock translates into a demand shock for local non-tradable goods and services, which in turn spurs firm entry. In particular, the model shows that

[3]We supplement standard practice in the entrepreneurship literature (e.g. Kerr et al. 2015; Babina 2015) with unique data on occupations to define a founder as the CEO or top paid manager of a new firm in the year of birth.

[4]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).

[5]We show that our results are fully robust to dropping those municipalities whose agricultural output ever exceeded more than 1% of the global total in any given year. The results are also robust to municipality by year fixed effects in our individual level regressions, which control for shocks correlated with entrepreneurial opportunities across all demographics.

commodity price shocks lead to increased local employment and aggregate income, which increases the profitability of firms catering to the local economy. This leads employees to transition from paid wage employment to entrepreneurship, thus generating new firm creation.

The model also highlights that the magnitude of the firm entry response depends on the willingness and ability of individuals in the local population to transition to entrepreneurship and take advantage of new economic opportunities when they arise. To the extent that this latent entrepreneurial potential is heterogeneous across individuals, the model emphasizes that the local composition of the population can meaningfully impact aggregate firm entry, local economic dynamics, and ultimately consumer welfare. Finally, and importantly, the model illustrates that responsive entrepreneurs, those on the margin of adjustment when an economy expands, can differ in substantive ways from other inframarginal entrepreneurs. This shows why it is important to study the population of individuals who create firms in response to well-defined, exogenous economic shocks, rather than entrepreneurs in general.

Empirically, we begin by confirming the model's aggregate-level prediction 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 sectors that are dependent on local demand (Basker and Miranda, 2016; Mian and Sufi, 2012b; Stroebel and Vavra, 2014), which in turn 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 4.5%.

We then turn to our main empirical analysis and explore the characteristics of those entrepreneurs who respond to local demand shocks by forming new firms. We start by focusing on the role of age in driving entrepreneurial responsiveness. 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 characteristic, the age profile of the population does not matter per se. Alternatively, we might expect older individuals to be more responsive, as they may have had the time to accumulate the experience, skill, and wealth needed to exploit new opportunities. Perhaps surprisingly, however, we find that the responsive entrepreneurs are almost entirely young individuals (less than 30 years old). Specifically, within municipalities that experience a large positive (top-decile) 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.

Our findings are consistent with the idea that lifecycle considerations strongly influence an individual's decision and ability to quickly respond to exogenous new local economic opportunities by forming a new venture. Indeed, younger individuals have been shown to have higher degrees of risk tolerance than older individuals, and thus may be better able to tolerate risks associated with a fast transition to entrepreneurial activity (Kihlstrom and Laffont, 1979; 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.[6]

Interestingly, we also find that responsive entrepreneurs are significantly younger than the average new 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 responsive entrepreneurs require the ability to rapidly act on exogenous changes in market conditions, which in turn may rely on a degree of flexibility and risk tolerance that is uniquely possessed by the young.

We next show that individual skills also appear to be key drivers of the firm creation response. We find that, among the young, more educated individuals are more responsive to local economic shocks by forming new firms. This is also the case for individuals who previously worked in positions requiring managerial and general business skill sets.[7] We finally provide evidence that it is both innate and acquired skills that matter, in that it is those individuals with greater occupational experience who are more responsive. On the other hand, we find that skilled but older individuals are not responsive to the local shock.

While skills appear to matter for the entrepreneurs driving the firm creation response during an economic expansion, a natural further question is whether these entrepreneurs are of similar quality to the average entrepreneur. On the one hand, when the economy is expanding, and thus drawing more individuals into entrepreneurship, the individuals on the margin may be of lower quality. On the other hand, we know that entrepreneurship and self-employment are a multi-faceted phenomena. For example, in developing countries subsistence entrepreneurship is prevalent (Schoar (2010)). Other individuals may become entrepreneurs simply due to large private benefits of self-employment (Hurst and Pugsley (2011)). In this way, responsive entrepreneurs, those acting specifically through changing market conditions, could actually be more skilled than the total pool of (inframarginal)

[6]One may be concerned that our findings are driven by the particular nature of the shock. For example, if the shock increases demand for local bars or nightclubs, it may not be surprising that younger individuals are better able to identify this shift in demand and take advantage of it. However, we find that the increase in local income following the shock is not concentrated specifically among the young, as one would expect if this were a "young specific" demand shock. In a similar vein, another potential concern is that the shock is actually relaxing financing constraints, with the young being more financially constrained than the old. This would imply, however, that controlling for income, educational status, white-collar status, and other covariates would likely reduce the estimated impact of age itself. However, the inclusion of such controls has almost no impact on the estimated effect.

[7]Following Autor et al. (2003) and Levine and Rubinstein (2017) we use detailed occupational data to identify occupations that involve significant cognitive skills, such as creativity and problem solving, as well as complex interpersonal skills such as negotiation and management.

entrepreneurs operating in the economy. Our evidence is in fact consistent with the latter. In particular, while 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 occupations that require cognitive skills, these traits are considerably more pronounced among the *responsive young* entrepreneurs who form businesses when local opportunities arise. This again reinforces the idea that the responsive entrepreneurs of our study are meaningfully different than the average entrepreneur, both in age and the skill sets they bring to bear.

In sum, our individual-level findings emphasize that both age and skills matter for the the decision of whether to become an entrepreneur in response to new opportunities, and that these individuals are different from the average new entrepreneurs in the economy. These findings also suggest that specific features of the economy may have important implications for aggregate entrepreneurial responsiveness.

First, the importance of individual skill may have implications for our understanding of how the informal sector contributes to entrepreneurial responsiveness. In many emerging countries, including Brazil, a significant share of economic activity occurs in the informal sector. La Porta and Shleifer (2008) and La Porta and Shleifer (2014), using World Bank surveys, document that informal sector firms arise primarily out of poverty and subsistence needs, while economic growth and dynamism come from a formal sector comprised of productive firms run by skilled, highly educated entrepreneurs. Based on these studies, one may hypothesize that entrepreneurial responsiveness to economic shocks would mostly be driven by the formal sector. Consistent with this hypothesis, using an annual large-scale survey in Brazil, we find no evidence that the number of informal firms and informal workers increases following the local demand shock, in sharp contrast to the formal sector response. Hence, when new economic opportunities arise, it is almost exclusively the young, educated, and skilled individuals in the formal sector who take advantage of them and drive firm entry.

Second, since the ability to create new firms hinges on access to finance, 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 by the young.[8] 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 of young individuals. We find suggestive, supportive empirical evidence for both of these hypotheses by comparing the individual response of the young across municipalities. Young individuals are indeed more responsive in municipalities with better access

[8] See for example Evans and Jovanovic (1989); Hurst and Lusardi (2004); Kerr and Nanda (2009b); Adelino et al. (2015); Holtz-Eakin et al. (1994b); Schmalz et al. (2017).

to finance, as proxied by the per capita number of banks based on the beginning of the sample. 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, again, as determined in the beginning of the sample.

Finally, our findings may also have long-term implications for entrepreneurial responsiveness and dynamism due to demographic trends. 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. Given our finding that the firm creation response is almost entirely concentrated among the young, an older population could directly lead to less firm entry in response to new economic opportunities when they occur. Moreover, the importance of acquired skills as well as age implies the possibility of additional indirect equilibrium effects amplifying the direct effect. As economies become older, skill acquisition for the young may become slower due to difficulties in moving up the job ladder (Liang et al., 2014). This in turn may further affect the overall entrepreneurial responsiveness and dynamism of the economy.

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. 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, and population composition, in affecting the entrepreneurial responsiveness of the economy.

Second, our paper contributes to a long-standing literature on the nature and characteristics of entrepreneurs.[9] Closely related to ours is Levine and Rubinstein (2017), who find that entrepreneurs running incorporated firms are likely to engage in tasks requiring comparatively strong cognitive abilities and engage in more illicit activities in their youth. Relatedly, Azoulay et al. (2017) find that successful entrepreneurs are on average experienced and middle-aged, rather than young. Consistent with their study, we find that the average entrepreneur is indeed older than those individuals who respond to changes in economic opportunities.[10] 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.[11]

The remainder of the paper proceeds as follows. Section 2 provides a theoretical framework. Section 3 describes the various data sources used in the analysis, while Section 4 describes the

[9]See Parker (2018) for an extensive review of the literature.

[10]Other studies have emphasized the importance of heterogenous selection into entrepreneurship following policy changes, with Nanda (2008) focusing on a tax reform in Denmark, and Hombert et al. (2014) studying the effects of unemployment insurance in France. We complement these studies by focusing instead on responsive entrepreneurs who start a business in reaction to local economic shocks.

[11]Our paper also relates to a large literature studying the role of entrepreneurship in developing countries. A few notable contributions to this literature include Bruhn et al. (2010); Naudé (2010); Desai (2011); Bianchi and Bobba (2012); Schoar (2010) and McKenzie and Woodruff (2013).

empirical strategy. Section 5 presents our municipality-level aggregate results. Section 6 describes the individual-level analysis and reports the key results of the paper. Finally, Section 7 builds on our individual-level findings and tests several theories suggesting that the composition of local economies may affect aggregate entrepreneurial responsiveness. Section 8 concludes.

2. 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 (2003); Chaney (2008)). The model features exogenous profitability shocks to the local resource sector.

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, while the local non-tradable sector is comprised of a continuum of differentiated goods, indexed by varieties ω.

2.1. Individuals

We assume that all individuals in the local economy have Cobb-Douglas preferences over the tradable and non-tradable goods, given by the specification in period t:

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

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

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

with $\sigma > 1$ and M_t equal to the equilibrium number of varieties produced in the non-tradable sector. This implies that all individuals spend a constant fraction $1-\alpha$ of their total income on tradable goods and a constant fraction α on the non-tradable composite. For simplicity, we assume that they do not consume the commodity product. 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:

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

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 in the overall economy, which means that we take the local wage in each period $w_1 = w_2 = w$ as exogenous and constant through time.

We denote the size of the initial local population at the beginning of the model's timeline as L_0. We assume that 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 fixed and equal to φL_0.[12] 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 $\pi_{t,N}$. Each entrepreneur produces a single differentiated variety, so the total number of entrepreneurs is equal to the number of varieties produced M_t. This implies that firm entry increases the variety in the economy. Consumer welfare thus depends on the number of entrepreneurs operating in the non-tradable sector, since consumers benefit from greater product diversity.

Intuitively, these individuals faced with the entrepreneurial choice are those who are sufficiently willing and capbale of becoming entrepreneurs, for example, those who are tolerant of risk and flexible in their personal circumstances. 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 this latent entrepreneurial pool who can respond to new opportunities.

We assume that this fraction φ of the existing local population, i.e. the pool of potential entrepreneurs, face non-pecuniary fixed costs associated with becoming an entrepreneur. Specifically, we assume that the distribution of non-pecuniary fixed costs F for this population is given by $G(F)$. We denote the density function for this distribution by $g(F)$. One can view these heterogeneous costs as arising from skill, as those who bring greater entrepreneurial and managerial skill to bear will likely find the burden of the running the business lower, although one could certainly interpret these costs more broadly.[13][14]

[12] 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. Relaxing this assumption would not change the results or key implications of the model, but would complicate matters since it would involve modeling the rest of the overall economy as a closed system.

[13] An alternative would be to model differences in skill through heterogeneous productivity levels. However, doing so would significantly increase the complexity of the analysis, while adding little in the way of intuition or the empirical implications of the model.

[14] 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 and to characteristics related to one's ability to engage in entrepreneurship. Allowing for this form of heterogeneous non-pecuniary costs is simply useful for tractability and expositional reasons. An equivalent modeling device would be to simply assume that there is a distribution G(F) of non-pecuniary costs

2.2. 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 $l_{t,C}$ 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 $1 > \phi > 0$ 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 in each sector:

$$(1-\gamma) A_{t,C} l_{t,C}^{-\gamma} = w \tag{2}$$

$$(1-\phi) A_{t,T} l_{t,T}^{-\phi} = w \tag{3}$$

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 (Krugman (1979); Melitz (2003); Chaney (2008)), 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. Market clearing requires production $q_{t,N}(\omega)$ equal demand $C_{t,N}(\omega)$ for each variety ω. Taking the aggregate price index as given, entrepreneurs set the price $p_{t,N}(\omega)$ to maximize profits

$$\pi_{t,N}(\omega) = C_{t,N}(\omega)\left(p_{t,N}(\omega) - w\right),$$

where $C_{t,N}(\omega)$ is consumer demand for variety ω, whose expression is provided above in equation (1). Taking the first order condition with respect to price yields the standard result in monopolistic competition that the price is equal to a constant markup over marginal cost.

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

among the entire initial population L_0 and that there is mass point at $F = \infty$ equal to $1 - \varphi$. This would not impact any of our key implications.

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 the 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:

$$M_t q_{t,N} = M_t l_{t,N} = \frac{\sigma-1}{\sigma}\frac{\alpha Y_t}{w}. \tag{4}$$

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

2.3. Equilibrium

In equilibrium, firms and individuals optimize and supply equals demand for labor. Note that the size of the local population in period $t = 1, 2$ is given by $L_t = l_{t,C} + l_{t,T} + l_{t,N} + M_t$. That is, the size of the local population is equal to the number of entrepreneurs in the local economy plus the number of salaried workers.[15] Aggregate income in the local economy equals:[16]

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

Note that the second equality arises because $l_{t,N}w + M_t\pi_{t,N} = \alpha Y_t$. Total revenue in the non-tradable sector αY_t is distributed as total wages paid to salaried workers $l_{t,N}w$ and total entrepreneurial profits $M_t\pi_{t,N}$. Solving the equation above for Y_t yields:

$$Y_t = \frac{(l_{t,C} + l_{t,T})\,w}{1-\alpha} \tag{5}$$

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

$$\pi_{t,N} - F_t^* = w. \tag{6}$$

[15] Recall that salaried workers can come from outside the local economy but all entrepreneurs come from the initial local population at the beginning of the model's timeline. Specifically, entrepreneurs come from the pool φL_0 of the initial local population.

[16] 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:

$$M_t = \varphi L_0 G\left(F_t^*\right) \tag{7}$$

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.

2.4. Propositions

Our empirical strategy relies on demand shocks that are driven by changes in global commodity prices. In this subsection, we explore the equilibrium implications of an exogenous increase in the price of the commodity good in period 2. All formal proofs are in Appendix Section A.1.

Proposition 1. *An increase in the price of the local commodity good between periods 1 and 2, $P_{2,C} > P_{1,C}$, 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 $A_{2,C}$ of the commodity sector, relative to period 1. 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 w. The amount of labor employed by the tradable sector remains unchanged. By equation (5), this inflow of workers raises aggregate income Y_2 in the local economy, relative to period 1, which shifts the demand $C_{2,N}\left(\omega\right)$ for non-tradable goods by the local population upwards. Since demand is homothetic and marginal costs are unchanged, the price $p_{t,N}\left(\omega\right)$ of the non-tradable goods does not change between periods 1 and 2. Therefore, by equation (4), relative to period 1, there is an increase in non-tradable output and higher employment in the non-tradable sector in period 2.

However, this would then imply that entrepreneurial profits $\pi_{2,N}$ are now higher than worker wages w, which remain fixed. Thus, if we now allow for the number of entrepreneurs to adjust, there will be firm entry, implying $M_2 > M_1$ as desired. Local workers who are willing/capable of entrepreneurship, i.e. those in the fraction φ of the initial local population L_0, and those with sufficiently low non-pecuniary costs F will become entrepreneurs, increasing the number of differentiated varieties and reducing entrepreneurial profits through greater competition. This will continue until the marginal entrepreneur is again indifferent between entrepreneurship and labor.

We explore these dynamics in Section 5 in the paper, illustrating how increases in commodity prices affect aggregate local income and employment across sectors (driven partly by employee migration). This in turn leads to a local demand shock and subsequent firm entry in the non-tradable sector. The model also implies the following proposition:

Proposition 2. *If the stock of potential entrepreneurs φL_0 increases, there is more firm entry in period 2 in response to the commodity price shock.*

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, and the larger the firm entry response. More firm entry also implies a larger increase in consumer welfare, since, as noted above, consumers benefit from greater product diversity. Another interesting implication of this result is that the larger the stock of potential entrepreneurs φL_0, the greater the non-tradable employment increase occuring on the extensive margin rather than on the intensive margin. That is, a larger pool of potential entrepreneurs means more of the employment creation occurs within new firms rather than within incumbent firms.[17] To the extent that this latent entrepreneurial potential, as reflected by φL_0, is determined by demographic characteristics of the local population, this second proposition strongly emphasizes that demographic local conditions can have significant implications for entrepreneurial responsiveness, local economic dynamism, and ultimately consumer welfare.

This second proposition motivates a key empirical goal, which is to explicitly identify the demographic determinants of φ. We take up this question in Section 6, relating the propensity to respond to new opportunities through entrepreneurship to age, education, and the skills acquired through prior employment.

We can finally use the model to explore the potential differences between "responsive" entrepreneurs and the average entrepreneur. One natural question, for example, is whether the entrepreneurs responding to the positive economic shocks are in some sense "worse" than the typical entrepreneur. We note that the difference in average F between responsive entrepreneurs and the total pool of entrepreneurs in period 2 is given by:

$$\Delta_2 = \frac{1}{M_2 - M_1} \int_{F_1^*}^{F_2^*} F g(F) \, dF - \frac{1}{M_2} \int_0^{F_2^*} F g(F) \, dF > 0.$$

Recall that M_2 is the total number of entpreneurs in period 2, while $M_2 - M_1$ is the number of responsive entpreneurs, i.e. the size of the firm creation response. The following simple proposition regarding the magnitude of this difference holds:

[17] In this model, the increase in non-tradable output and employment is independent of the amount of firm entry. This can be seen from equation (4). Firm entry determines the margin on which the increases occur, either the intensive or extensive margin. 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.

Proposition 3. *As the heterogeneity in non-pecuniary costs F among the population of potential entrepreneurs φL_0 approaches zero, the difference Δ_2 between the level of non-pecuniary cost of responsive entrepreneurs and average entrepreneurs also approaches zero.*

Simply put, in the limiting case when there is no heterogeneity in F, the responsive entrepreneur must look exactly like the average entrepreneur.$(F < F_2^*)$.[18] On the other hand, for distributions with greater heterogeneity, the new entrants $(F_1^* < F < F_2^*)$ will have significantly higher F than the average entrepreneur To the extent that we can identify F with skill, for example, the model therefore shows that responsive entrepreneurs could be either worse than the average entrepreneur in terms of skill, or alternatively may look quite similar, depending on the characteristics of the pool of potential entrepreneurs denoted by $G(F)$ in the model.

Moreover, our current model is simplistic in the sense that it neglects other important sources and types of entrepreneurship. For example, in developing economies subsistence entrepreneurship is quite prevalent. We could formally model such subsistence entrepreneurs in an extension of our framework as a group of highly unproductive individuals blocked from wage employment and forced into self-employment. These individuals would produce less output and earn significantly lower profits than the entrepreneurs we currently have in the model. In such an extended model, when we compared those entrepreneurs driving the firm entry response to the total pool of entrepreneurs in the economy, it could easily be the case that the former actually looked more skilled than the latter.[19]

Ultimately, the model illustrates that whether responsive entrepreneurs are more or less skilled than the average, as well as other characteristic differences, are empirical questions. Understanding these differences is the second key aspect of our empirical analysis. Our framework further demonstrates why it is important to study the key demographic determinants of firm creation in response to a well-defined demand shock, rather than entrepreneurship in general, as those individuals driving the mportant firm entry dynamics of the economy may differ in substantive ways from inframarginal entrepreneurs.

3. 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

[18]More formally, let $supp\,(G) = \{F : g\,(F) > 0\}$ denote the support of g and let $l_g = sup\,(supp\,(G)) - inf\,(supp\,(G))$ denote the length of the support. As $l_g \to 0$, that is as heterogeneity in non-pecuniary costs F approaches zero, it follows that $F_1^*, F_2^* \to inf\,(supp\,(G))$, which in turn necessarily implies $\Delta_2 \to 0$.

[19]In a similar vein, Hurst and Pugsley (2011) argue that many individuals choose self-employment due to non-pecuniary private benefits. In the context of our model, such individuals would have a low F and would thus be inframarginal. However, such individuals need not be particularly skilled. Indeed, Hurst and Pugsley (2011) show that the growth potential of the businesses managed by such individuals is quite limited. As with subsistence entrepreneurs, the existence of such individuals imples that the entrepreneurs driving the firm creation response could look more skilled than the overall pool.

sector in Brazil. We supplement these data with data on municipal agricultural crop endowments, as well as data on global commodity prices and accessory datasets discussed in the text.

3.1. Employer-Employee Data

The RAIS (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. RAIS is widely considered a high quality Census of the Brazilian labor market (Dix-Carneiro, 2014). The database, created in 1976, is used by several 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).[20] 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.[21] We supplement standard practice in the entrepreneurship literature (e.g. Kerr et al. 2015; Babina 2015) with detailed occupational data, and define an entrepreneur as the CEO of a new firm in the year of birth. If no worker is classified as CEO, we use the highest paid manager, or ultimately the highest paid worker in the firm when there are no managers in the firm.

Furthermore, following Autor et al. (2003), Gathmann and Schönberg (2010), and Levine and

[20] 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.

[21] 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. See Colonnelli and Prem (2017) for more details on the data construction.

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 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. 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, and that produce crops at any point in time, and derive a final sample of 5,443 municipalities.[22] 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. We finally extract a random 10% sample of the these data to overcome computational barriers. The entire analysis focuses on the period 1998-2014, since we rely on the prior 5 years (1993-1997) to construct the historical agricultural endowments, as discussed in Section 4. All statistics in the paper refer to these samples.

In Panel A of Table 1, we provide summary statistics on the relative importance of different 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 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

[22] The population restriction simply helps to overcome computational constraints in the individual level analysis.

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 average worker is 35.6 years old, while the average new entrepreneur is significantly younger at 31.9 years old.

3.2. 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.

Panel B of Table 1 illustrates that the average aggregate dollar value of local crops in a municipality across all years in our sample 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 of 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 than what the figure suggests, given that different municipalities specialize in different portfolios of agricultural products.

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 the 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. We list the distribution of these agricultural commodities across municipalities in Table A.1.

4. 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, the main identification threat to our primary individual-level analysis is that unobserved shocks to the investment opportunities of specific sets of individuals could mechanically affect 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.[23] 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.[24] Specifically, let $Q_{kj,98}$ be our proxy for the regional

[23]This approach is standard in the literature (see, for example, the discussions in Dube and Vargas (2013); Goldsmith-Pinkham et al. (2018); Jaeger et al. (2018)).

[24]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

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 Crops Index can be viewed as an endowment-weighted average of total commodity values in affected municipalities. 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 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.[25] A body of recent studies has used the framework of instrumental variables to formalize the identification assumptions underpinning the validity of shift-share research designs (Goldsmith-Pinkham et al. (2018); Borusyak et al. (2018); Jaeger et al. (2018); Adão et al. (2018)). Our approach fits well into the framework developed by Borusyak et al. (2018), who argue that shift-share designs provide causal estimates as long as the shocks themselves are exogenous to local economic conditions.[26] Borusyak et al. (2018) further emphasize that panel-data settings, with several periods and a large number of shocks, in which it is possible to flexibly control for both location and time fixed effects, are especially well suited for such empirical designs. This is precisely the case in our context, as we are able to exploit commodity shocks across thousands of municipalities and over a long time series.

The primary identification risk with this approach is that unobserved municipality level shocks in Brazil could impact global commodity prices, biasing the results. More specifically, since we can control for municipality by year fixed effects in our main analysis at the individual-level, our identification would be threatened by *within*-municipality shocks increasing entrepreneurial opportunities for a particular demographic, while also influencing global commodity prices. As noted above, this concern is significantly mitigated by the fact that our analysis exploits shocks across thousands of local municipalities. We nonetheless directly address this general concern in Section 5.2.1, by

and soil.

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

[26]While sufficient for identification, the exogeneity of the cross-sectional distribution of commodity shares across locations (Goldsmith-Pinkham et al. (2018)) is not a necessary condition for the validity of the research design.

dropping those municipalities which, in any year, ever constituted more than 1% or 0.5% share of the total global output in a specific commodity.

In our main municipality-level specifications, we examine the impact of local endowment shocks in the top 10th percentile of crops index fluctuations within a municipality. Specifically, we first estimate the model:

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

including year and municipality fixed effects. 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 A.1 in the Appendix 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 $Z_{jt} = 1$. Importantly, as we discuss in Section 6, the choice of a binary shock allows us to 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 new entrepreneur in the economy. This choice, however, is not driving any of our findings. Both at the municipality and individual level, the results are robust to the use of the continuous measure of the index, namely $\ln(CI_{jt})$, 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 5.2.

5. Municipality-Level Analysis

Motivated by the theoretical predictions of the model described in Section 2, we start by estimating the impact of global commodity price fluctuations on municipality level economic activity:

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

where Y_{jt} is the municipality-level outcome variable 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.

5.1. *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 higher employment. 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 2, 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 by aggregate payroll across all local firms.

Consistent with the model in Section 2, 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).

Table 3 illustrates the impact of the shock by economic sector, which we categorize using the Brazilian CNAE industry codes into Agriculture and Mining (column 1), Manufacturing (column 2), and Non-tradable and Services (column 3).[27] 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 sector responsible for the production of these commodities (Agriculture and Mining). Moreover, the evidence points to the presence of positive spillover effects to other sectors, as illustrated for example by the rise of 5.9% in employment in Non-tradable and Services . 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/services sector (column 3), where we observe a highly statistically significant increase of 5.5%, 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 and firm entry for the dynamics of local economic activity. All of these findings, moreover, are consistent with the model presented in Section 2, 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/services sector. Our findings are also consistent with Adelino et al. (2017), who study the U.S. and similarly find that local income shocks lead to a significant response by new firms in the non-tradable sector.

[27] 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.

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 may be short-lived, therefore contributing 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.[28]

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. These results are consistent with Sedláček and Sterk (2017), who find that firm success is influenced by aggregate conditions at the time of entry.

5.2. Robustness

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.

5.2.1. Influencing Global Commodity Prices

The key endogeneity concern with our approach is that the local agricultural sector is sufficiently large relative to global production to potentially influence international prices. In that case, 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 analysis is at the municipality level, rather than at the national level. Therefore, the concern is that *municipality* level shocks could affect *global* commodity prices. To add an even further layer of complexity, our analysis in Section 6 also relies on individual-level variation *within* municipalities, making the identification threat even more nuanced. There, the concern arises from potential shocks in one of more than five thousand municipalities increasing firm creation opportunities for specific segments of the local population, while also impacting the prices of commodities traded on world markets.

[28] 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.

To test the robustness of our results and evaluate the plausibility of this channel, 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.

5.2.2. 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 statistically significant, except for the small and insignificant effects on firm closures. Hence, these results illustrate that our findings do not seem to be driven by a particular choice of the functional form.

5.2.3. 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 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), local economic activity continues to positively respond one to four years after the commodity endowment shocks, and then gradually declines.

6. Individual-Level Analysis

The model in Section 2 highlights the importance of individual heterogeneity in driving the magnitude of the entrepreneurial responsiveness to economic shocks. Motivated by this theory, we now move to our primary empirical analysis and attempt to identify the key characteristics of those individuals who respond to local demand shocks by creating new firms. We conduct this analysis at the individual, rather than municipality, level so as to fully exploit the richness of our micro data and run regressions with batteries of demographic controls.

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 3.[29] 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:

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

where α_j denote municipality fixed effects, and δ_t denote year fixed effects. Here, β captures the direct effect of the local endowment shock on the individual's choice to form a new firm, and X_{ijt} control for individual-specific characteristics.[30] Standard errors are clustered at the municipality level. Importantly, in this analysis, we focus on individuals who are already working in the municipality rather than individuals that migrate from elsewhere, so as to cleanly identify the individuals who experience the change in local demand and investment opportunities. That is, consistent with our theoretical framework, we focus on the individual decisions of local wage workers to switch to entrepreneurship.

Motivated by prior work on the importance of lifecycle considerations for entrepreneurial choice, we begin our analysis by studying heterogeneity in entrepreneurial responsiveness by age.[31] We then study how the presence of various skills, such as those acquired through both education and prior employment, impacts the decision of whether to start a firm in the face of new economic opportunities. In both cases, we additionally examine whether the "responsive" entrepreneurs of

[29] We multiply these indicator variables for entrepreneurs by 1,000, to ease the interpretation of the coefficients.

[30] We sequentially add various individual-specific controls to the empirical specifications. These include education dummies equal to one if the individual has a high-school diploma or higher, occupation dummies equal to one if the previous occupation is in a white collar position, a control for the skill level required in the job (i.e., non-routine cognitive occupations versus others), and a variable ranking individual experience within the firm. Finally, we also control for the rank of the individual within the income distribution in a given municipality.

[31] See Parker (2018) for a comprehensive survey of the literature on factors that determine individual transitions to entrepreneurship.

our study, namely those responding to changing market conditions, differ in meaningful ways from the average new entrepreneur. The procedure for doing this, which hinges on simple econometric insights and is described Section A.2 in the Appendix, allows us to precisely characterize and compare the unique distributional features of both populations.

6.1. *The Firm Creation Response by Age*

Relying on the econometric framework outlined in the previous section, we first investigate heterogeneity by age in the firm creation response to local demand shocks. Figure 2 reports the increase in entrepreneurial rates in response to the shock, estimated with model (4), for different age quartiles.[32] 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.

We refine this analysis in Table 5. Column 1 shows the simple entrepreneurial responsiveness to the shock, controlling only for year and municipality fixed effects. The shock leads to an increase of 0.144 (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.[33] This column conveys the same message as Figure 2. Young individuals exhibit a striking responsiveness, more than 6 times larger, when compared to the rest of the population.[34] A more stringent specification is presented in column 6, where we control for municipality by year fixed effects, effectively comparing individuals subject to exactly the same municipality-year shock, but who differ in age. The resulting coefficient, albeit somewhat smaller than in the previous specifications, remains positive and strongly statistically significant. The inclusion of such fixed effects addresses a number of standard Bartik concerns by controlling for any municipality-wide increase in entrepreneurial opportunities shared across all demographics.[35]

[32]The 25th percentile of the age distribution in the analysis sample is 27, the median is 34, and the 75th percentile is 43. As discussed earlier, the sample is restricted to individuals between 18 and 65 years old.

[33]We also interact municipality fixed effects with the young indicator to allow greater flexibility in capturing unobserved characteristics.

[34]Specifically, the magnitude is obtained as: $\frac{0.058+0.298}{0.058} \approx 6.13$.

[35]These results are robust to various alternative treatment definitions. In Appendix Table A.7 , we explore an alternative positive economic shock, equal to one if in the top 25th percentile within a municipality and zero otherwise. We also explore the effects of negative shocks, defined as those in the bottom 10th or 25th percentiles of the commodity price change distribution 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.

We next compare the distributional characteristics by age of the responsive entrepreneurs to the average new entrepreneurs in the population, and show that the former are indeed different than the latter.[36] Specifically, 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 3 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. Figure 3 shows that the entire age distribution of the responsive entrepreneurs is tilted towards younger demographics, when compared to the average new entrepreneur in the economy.

6.2. Lifecycle Considerations

The disproportionate response of the young to new entrepreneurial opportunities is perhaps surprising. First, 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 characteristic, the age profile of the population does not matter per se. On the other hand, individuals may accumulate general business and managerial skills over time, and to the extent that such skills are necessary to take advantage of changes in local opportunities, one might have expected older individuals to be more responsive (Lazear, 2005; Evans and Leighton, 1989). Similarly, to the extent that financing constraints affect the ability to start a new business, we may once again have expected that older individuals would be more responsive to new opportunities, having had more time to develop the necessary personal wealth (Quadrini, 1999).

Instead, we find that it is the young who generate, almost entirely, the firm creation response. Existing studies have proposed a variety of lifecycle mechanisms that could potentially explain why the young may be more able and willing to respond to new economic opportunities. For example, young individuals may have a greater tolerance for risk or an overall higher degree of flexibility in their personal and family circumstances, thus allowing them to seize opportunities quickly as they arise.[37]

Of course, it is difficult to say with certainty that the higher responsiveness of the young is driven purely by lifecycle considerations. For instance, our results could potentially reflect other characteristics influencing the entrepreneurial response, but which are themselves correlated with age. While

[36]The calculation of the age distribution of the "responsive" entrepreneurs is described in detail in Section A.2 in the Appendix. Intuitively, the methodology uses Bayes' Rule to show that the proportion of responsive entrepreneurs that are young, divided by the fraction of the total population that is young, is equal to the firm creation response of the young, divided by the overall firm creation response. Since the distributional age characteristics of the overall population can be calculated, this relationship allows the distributional age characteristics of responsive entrepreneurs population to be determined as well.

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

it is admittedly challenging to identify precisely the mechanism underlying the disproportionate response of the young, we attempt to shed light on the importance of lifecycle considerations by relying on the highly granular individual-level data available in our setting.

Specifically, we show that when gradually adding a battery of individual-level characteristics, the estimates of the entrepreneurial responsiveness of the young remain essentially unchanged. For example, in column 3 of Table 5 we add controls for educational achievement, including indicator variables for whether the individual has a high school diploma, or higher education. In column 4 we additionally control for the occupational characteristics of the previous job (e.g., whether she was a white collar worker, or was working in an occupation requiring non-routine cognitive skills), as well as years of experience within the firm. Finally, in column 5, we also control for the wage in the previous job. Remarkably, including all these additional controls has essentially no impact whatsoever on the estimated effect of age. Even when adding these controls to the specification with municipality by year fixed effects, in column 7, the estimates remain mostly unchanged relative to column 6. In sum, this evidence strongly suggests that lifecycle-specific features, such as individual risk aversion and flexibility, are important driving forces in our results on age. For instance, column 5 rules out an alternative explanation in which younger individuals earn lower wages, and it is this lower outside option that is truly driving the disproportionate firm creation response. Overall, our results are consistent with the notion that the ability to respond quickly to new economic opportunities depends crucially on traits disproportionately possessed by the young, such as flexibility, and tolerance of risk. In the next section we consider a set of alternative interpretations and argue that they are unlikely to be consistent with our findings.

6.3. Robustness to Alternative Interpretations

In this subsection, we further consider whether the disproportionate response of the young could be driven by alternative interpretations. First, we consider the possibility of attrition, in which older individuals are less responsive since they may have already started a business. We also discuss issues related to the nature of the shock. In particular, we consider whether the commodity shock increases the demand for certain goods and services which the young are particularly well-suited to provide. In a similar vein, we consider whether the shock is actually operating as a relaxation of local financing constraints primarily benefiting young individuals.

6.3.1. Attrition due to Early Formation of Businesses

An important consideration with respect to the interpretation of the results is the issue of attrition. That is, the results may be mechanically driven by compositional changes in the set of potential entrepreneurs that occur over time: older individuals may appear to be less responsive to changes in local opportunities simply because they have already responded to previous opportunities by starting a business.

To explore whether this can explain our findings, we study whether the results would change if we *assume* that recently established entrepreneurs were also to respond to the shock. To do so, we redefine the dependent variable Founder as *Pre-Founder*, if the individual has ever founded a firm in the past (or in the current year) and that firm is still operating. *Pre-Founder* equals 0 otherwise. This new dependent variable thus considers individuals who already started businesses in the past as responding to the local demand shock, which is the most extreme scenario under which our results would be invalidated if attrition were playing a major role. The results with this modified definition of the dependent variable are reported in Table A.8 Panel A.[38]

We find that both the baseline findings on individual firm creation, and the strong responsiveness of young individuals hold. As expected, since by construction we assume a larger number of individuals to respond to the shock, we find that the point estimates of the main effect (column 1) and the interaction effect of the young (columns 2 to 5) are significantly larger. However, as illustrated in column 2, young individuals' sensitivity to the shock remains disproportionately higher. This suggests that the proposed mechanical explanation due to attrition does not seem to drive our findings.

An alternative test to rule out attrition is to directly control for past entrepreneurial experience. Specifically, we add an indicator variable that equals one if the individual was ever a founder in the past. The results are are reported in Table A.9 Panel A. We first find that the coefficients on past-entrepreneur are positively correlated with the likelihood to become an entrepreneur, and the effects are statistically significant. This immediately goes against the attrition story, since it relies on older individuals who have already started a business being less likely to respond. Table A.9 further shows that, even when comparing young and old individuals of similar past entrepreneurial experience, the point estimates of the young interaction term remain completely unchanged when compared to Table 5. This strongly suggests that having been an entrepreneur in the past is not driving the relative increased responsiveness of the young.[39]

6.3.2. Nature of the Shock

An alternative explanation for the results is that the shock we are considering is "young-specific." The concern is that the local demand shock may disproportionately increase the local wages of the young and thus increase the demand for specific goods and services that cater to the young, and that young entrepreneurs are better positioned to provide.

[38]In Panel B of Table A.8 we repeat the same exercise, but this time define *Pre-Founder* if the individual has founded a firm in the past 5 years (or in the current year) and the firm is still operating. The results remain unchanged.

[39]In Panel B of Table A.9 we add an indicator variable that equals 1 if the individual was an entrepreneur in the past 5 years. The results remain unchanged.

We therefore investigate whether the increase in employment and income following the commodity price shock is concentrated among the young population. To do so, we re-estimate our main aggregate results, presented in Table 2, separately for different age segments within municipalities. The results are reported in Panels A and B in Table A.10. Interestingly, we find that the rise in both employment and income following the economic shock are in fact somewhat *less* concentrated among young individuals, relative to the older segment of the population. In response to the shock, the number of employees in the bottom quartile of the age distribution grows by 5.3%, while it grows by 6.2% in the top quartile, and the growth is non-monotonic, peaking in the third quartile at 7.2%. Similarly, income grows by 5.5% in the bottom quartile and by 7.2% in the top quartile. This evidence seems to be inconsistent with the notion that this demand shock is "young specific," which in turn would allow young entrepreneurs to be better positioned to take advantage of it.

An additional and somewhat related possible explanation for the increased responsiveness of the young is that the commodity shock itself acts as a financing shock alleviating financial constraints. For instance, the shock might raise local land and home prices, improving collateral values. Then, to the extent that young individuals are more financially constrained than the old, we might expect a larger firm creation response among the young.

However, we believe that such an explanation is quite unlikely in the context of Brazil, where financial instruments like home equity loans are close to non-existent in our sample period. Furthermore, since older individuals are more likely to be home owners, it is surprising that we find no response at all among the old to the shock.

Finally, we would expect the young to be more financially constrained because of other, more fundamental demographic traits, such as having lower income and lower wealth. Yet, as noted previously, when we include a battery of demographic and career characteristics which likely proxy for the severity of individual financing constraints, including income, educational status, and white-collar status, the estimated effect of entrepreneurial responsiveness of the young remains entirely unchanged, suggesting that a relaxation of financing constraints is unlikely to be driving the results.

6.4. 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. In this section, we show that age in itself is not sufficient to account for the firm creation response. Motivated by a large literature on the nature of entrepreneurs, we show that skills also strongly affect an individual's entrepreneurial responsiveness to local economic opportunities (e.g., Evans and Leighton (1989), Lazear (2004), among others). To show this, we explore heterogeneity in the firm creation response *within* the population of young individuals, focusing on several proxies for an individual's skill set.

Panel A of Table 6 shows that skill and experience are significant determinants of individual responsiveness within the population of young individuals. We estimate the main specification in equation (4) across various sample splits, including year and municipality fixed effects. The aim is to characterize skilled versus unskilled individuals within the young population. First, in columns 1 and 2 we split the population based on the level of education. In column 1 we focus on individuals who have at least a high school diploma. We find that within this population, individuals are highly responsive to the economic shock by forming new ventures, and the effect is highly statistically significant. The treatment increases the likelihood of starting a firm by 0.468 in 1,000 in this group, approximately a 16.1% increase from the baseline flow in the population. Moreover, when we focus on individuals with less than 12 years of education, we find that this population is not responsive, with the estimate close to zero and insignificant.

In columns 3 and 4 we characterize the skill sets of individuals based on information regarding their previous occupation. We find that individuals who were previously working in occupations that required non-routine cognitive skills 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 communication, negotiation, and management. The effects for this subpopulation, documented in column 3, are particularly large, with the estimate equal to 0.813 and statistically significant at 1% level. Relative to the average flow into entrepreneurship, this estimate reflects an increase of 28% within this population. In contrast, the responsiveness to the economic shock in the remaining sub-population, as shown in column 4, is significantly lower with a coefficient of 0.242, although still statistically significant at 5% level.

Given these findings, it is natural to ask whether individuals sort into these occupations because they possess these skills, or whether individuals acquire relevant entrepreneurial skills by working in such occupations over time. That is, does experience matter? We test this in columns 5 and 6 by splitting young individuals (within the same firm), above and below the median of number of years of experience. We find that more experienced young individuals are almost four times more responsive than those with less experience. In column 5, the coefficient is equal to 0.566 and is highly statistically significant, in contrast to less experienced individuals, for whom we estimate a statistically insignificant coefficient of 0.147. These results are consistent with Lazear (2004) and other empirical studies emphasizing the importance of ability and acquired skills for entrepreneurial responsiveness.[40]

In Panel B of Table 6 we repeat the analysis for older individuals, by excluding all individuals in the bottom quartile of the age distribution. Strikingly, but conceptually in line with our previous results, Panel B 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

[40] 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 all sample splits are indeed statistically significant.

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 provides further strong support for the joint importance of lifecycle considerations, together with experience and skills, in allowing individuals to form new businesses in response to rapid changes in local opportunities.

Finally, as we did when studying age, we show that the "responsive" entrepreneurs differ in significant and meaningful ways, based on skill characteristics, from the average new entrepreneur. As our model illustrated, depending on the strength of various forces, one might expect the entrepreneurs driving firm entry to be of higher or lower skill tha the average. Our results are shown in Figure 4, focusing on young individuals only.[41] We first note that the average young entrepreneur is, in fact, quite similar to the average young individual in the population. While the average young entrepreneur is slightly more educated, she has similar levels of general business, communication, and managerial skills compared to the average individual in the population, as measured by working in occupations that require cognitive non-routine skills, and she is only slightly more experienced. 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 above median work experience. 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 and educated, and are more likely to have worked in occupations that require general business and managerial skills. 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. Our findings thus emphasize the joint importance of age, in addition to experience and skill, in driving an individual's ability and willingness to become an entrepreneur in response to exogenous economic shocks.

7. 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, through the lens of supporting empirical evidence, we further argue that this individual-level heterogeneity implies that specific features of the local economy may have important implications for its entrepreneurial responsiveness. Specifically, we discuss the role of the informal sector, and the impact of local municipal characteristics such as

[41] Section A.2 in the Appendix illustrates the calculation of the distribution of "responsive" entrepreneurs.

availability of financing and the concentration of skilled human capital.

7.1. *The Informal Sector*

The analysis up until this point has focused exclusively on firm creation responses in the formal sector. In many emerging countries, including Brazil, a significant share of economic activity occurs in the informal sector (Ulyssea (2018)). This raises the question of whether the informal sector is also important in driving the entrepreneurial response we observe.

Our individual-level results have emphasized the importance of education and acquired business skills in the firm creation response. Using data from World Bank surveys, La Porta and Shleifer (2008) and La Porta and Shleifer (2014) show that the informal sector tends to arise out of subsistence needs and that informal firms are run by largely unskilled, unproductive individuals. As a result, informal sector firms tend to be small, do not grow, and are considerably less productive than formal sector ones. In contrast, these studies argue, formal sector firms in developing economies tend to be run by highly skilled and highly educated entrepreneurs. Given these findings, a natural hypothesis is that the firm creation response to new economic opportunities is largely driven by the formal sector.

Testing this hypothesis is challenging due to the obvious limitations 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 study the responsiveness to local commodity price shocks of both the formal and informal sectors. 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.[42]

Table 7 reports the elasticity of the number of formal and informal firms and employees 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 changes, 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). 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.

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

These results provide support for the dual view of developing economies as argued by La Porta and Shleifer (2008) and La Porta and Shleifer (2014), in which the informal sector firms arise primarily out of poverty, while economic growth and dynamism come from a formal sector comprised of productive firms run by skilled, highly educated entrepreneurs. This is exactly what our individual-level empirical evidence suggests. When new economic opportunities arise due to increases in local demand, there is no firm creation response in the informal sector. Rather, it is precisely the young, educated entrepreneurs in the formal sector with the requisite business and managerial skill sets who appear to take advantage of them.

7.2. 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 when economic shocks occur due to global commodity prices. Specifically, we explore the importance of local availability of financing and the local stock of human capital. In both cases, we provide suggestive evidence consistent with these theories using individual level analysis that compares individuals' entrepreneurial responsiveness across different municipalities to global movement in commodity prices.

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 of the distribution of a specific characteristic of interest. We study three specific measures. We proxy for local access to finance using the total number of unique bank institutions per capita (so as to account for scale effects).[43] 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. 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.[44] In Table 8 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).[45]

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

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

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

7.2.1. Local Financing Availability

As discussed earlier, the ability to create new firms in response to new economic opportunities hinges on access to finance. Wealth required to satisfy downpayment or collateral demands would likely be needed to form a new business. Given that 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 8 confirm this hypothesis. In column 1 we find that young individuals in municipalities with greater access to finance form significantly more businesses in response to local demand shocks. The effects remain similar when we add individual level controls, as shown in column 2. These results are consistent with the interpretation that local financing availability enhances the ability of young individuals, who are more responsive but also more likely to be financially constrained, to start a new business and take advantage of local opportunities.

7.2.2. Local Human Capital Availability

Given the importance of skill and experience in explaining individuals' entrepreneurial responsiveness, we further 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, both constructed at the beginning of the sample, as defined earlier. Using either measure, in columns 3 and 5 of Table 8 we find an enhanced responsiveness of young individuals in municipalities with a high level of human capital, consistent with these theories. Importantly, we find that these results hold also when controlling for individual characteristics. That is, columns 4 and 6 show that even individuals with similar levels of skill, as measured by their education and past occupations' characteristics, are more likely to transition to entrepreneurship in response to local demand shocks in municipalities with a greater concentration of human capital.

8. 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.

We then explore several implications that may arise from these heterogeneity findings. We first show that entrepreneurial responsiveness arises almost entirely from the formal sector, consistent with the importance of skill. Second, when exploring entrepreneurial responsiveness across municipalities, we find a larger response of young individuals in municipalities with better access to finance, and where more skilled human capital is widely available, consistent with various theories that highlight the importance of access to capital for the young, and human capital externalities for the skilled. Overall, these findings further emphasize how the composition of the local population can have a significant impact on the entrepreneurial responsiveness of the economy.

Finally, our findings may also have long-term implications for economic dynamism due to demographic trends. One of the most profound demographic transitions of the past 50 years has been towards aging populations, stemming from both declines in fertility rates and increased longevity. Given our finding that the firm creation response is almost entirely concentrated among the young, aging population may directly lead to less firm entry in response to new economic opportunities. Our results emphasize also the importance of skill and experience in driving entrepreneurial responsiveness. Liang et al. (2014) argue that, in older populations, young individuals might have a more difficult time moving up the job ladder into more managerial positions and acquire skill. The difficulty of young individuals to acquire skills in aging populations may further limit the entrepreneurial responsiveness of the economy. While direct investigation of these implications is beyond the scope of this paper, these issues provide an interesting future research agenda.

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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.

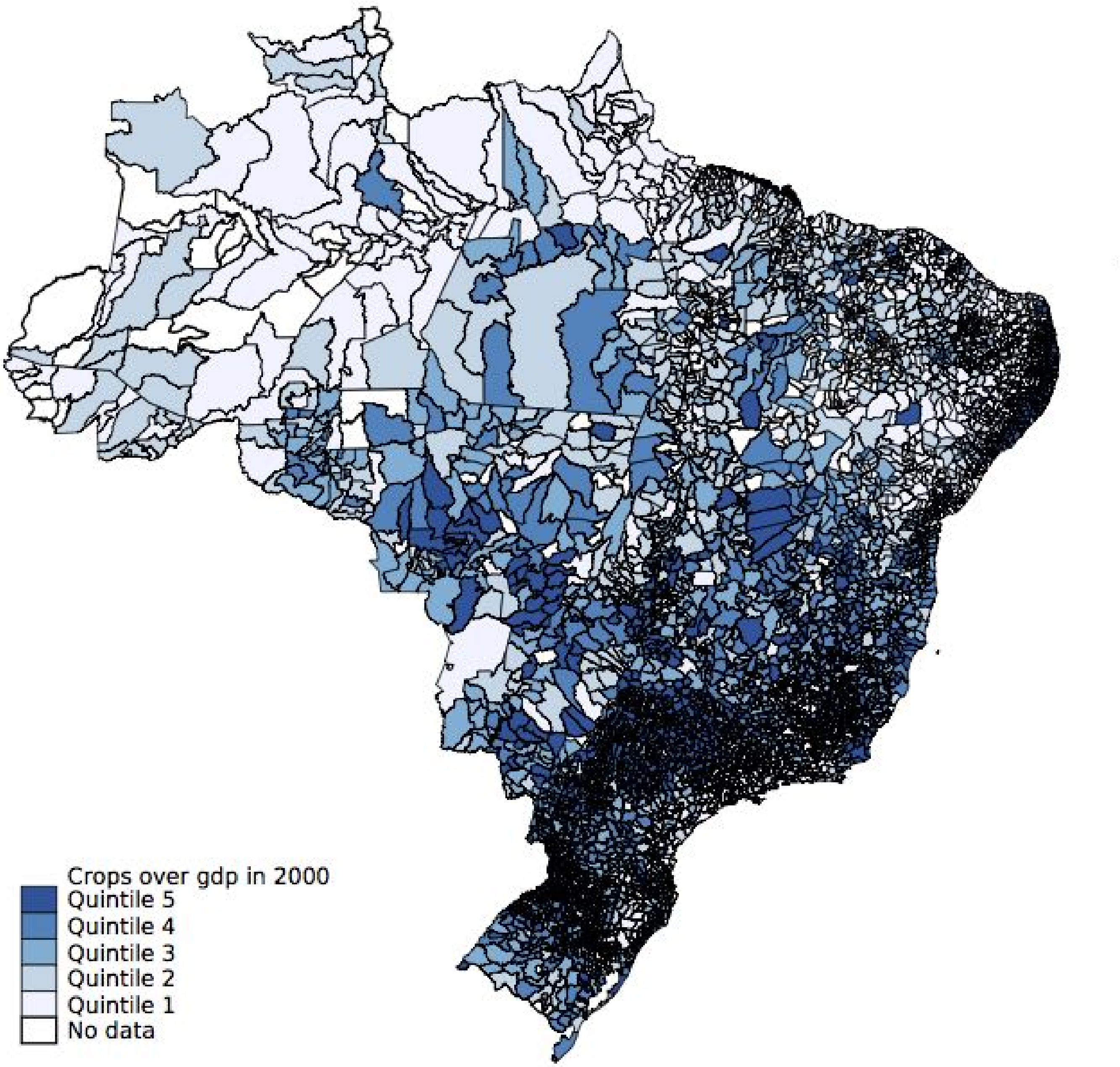

Figure 2
Entrepreneurial Response by Age Group

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 errors clustered at the municipality level. The magnitudes of the coefficients are in per-thousand points.

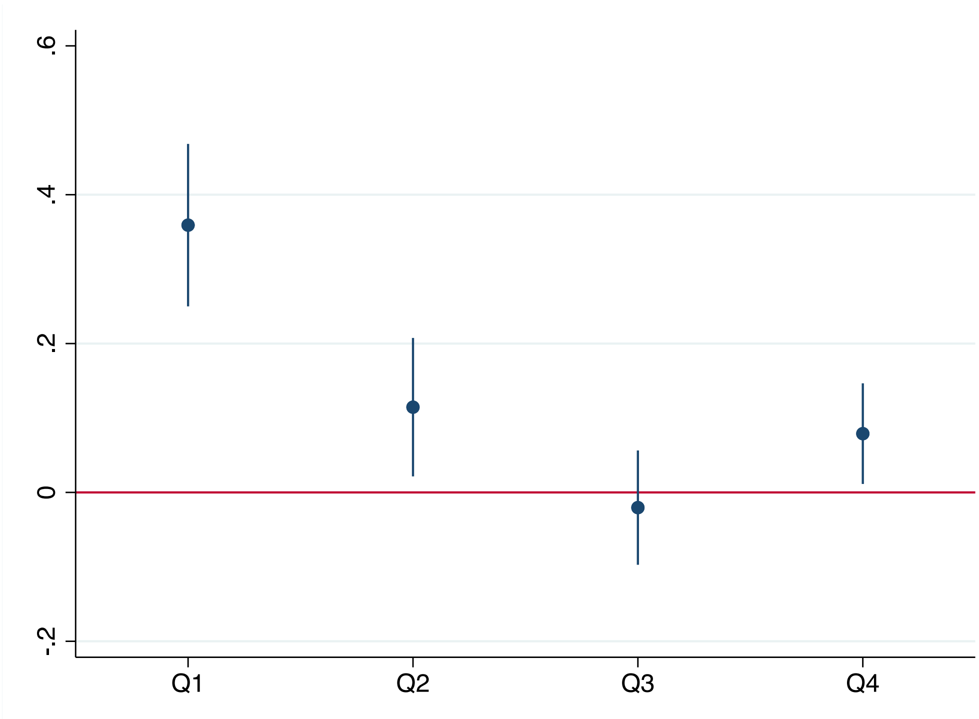

Figure 3
Comparison of Age Distribution

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 of 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 age quartile n (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 in the Appendix.

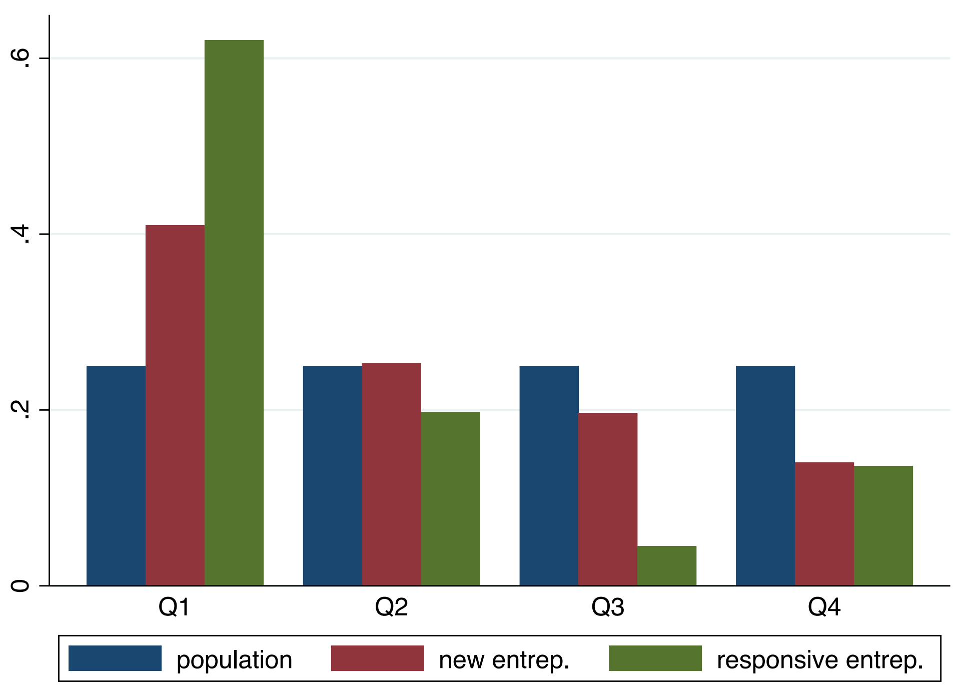

Figure 4
Comparison of Skill Distribution

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 3, and as discussed in Section A.2 in the Appendix.

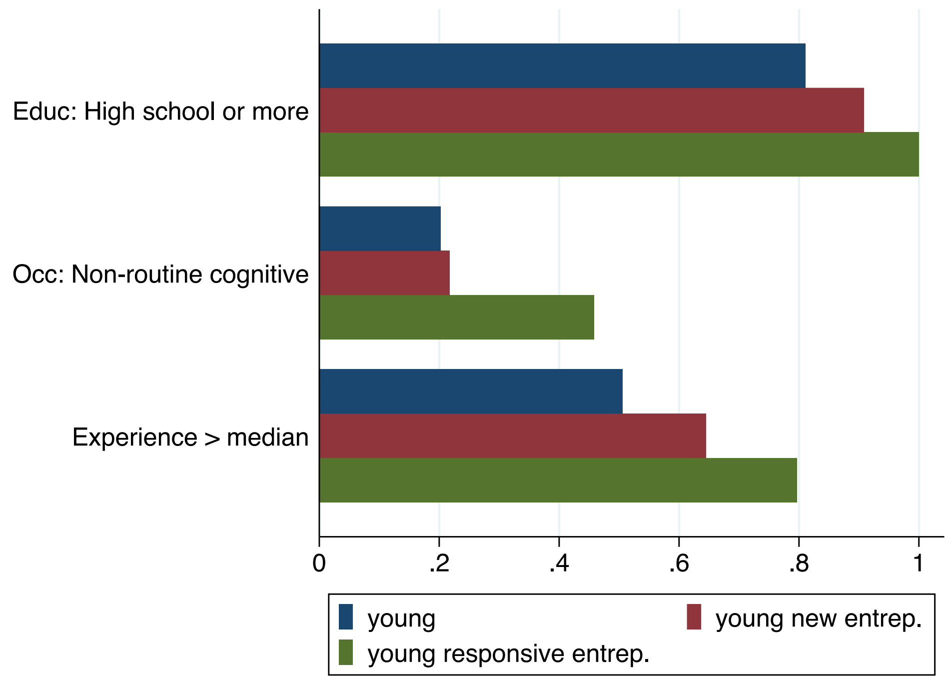

Table 1

Summary Statistics

This table reports summary statistics on the main analysis samples, as described in Section 3. 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
Agriculture/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

	Population		Founders
	Obs.	Mean	Mean
Founders of new firm (every 1000)	23,838,803	2.91	-
Males	23,838,803	61%	57%
Age	23,838,803	35.6	31.9
Blue collar worker	23,838,803	48%	40%
White collar worker	23,838,803	42%	50%
Manager	23,838,803	4%	4%
Education dummy: less than High School	23,838,803	32%	17%
Education dummy: High School	23,838,803	47%	64%
Education dummy: more than High School	23,838,803	21%	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 3. The empirical specification is $Y_{jt} = \alpha_j + \delta_t + \beta Z_{jt} + \gamma X_{jt} + u_{jt}$, as described in Section 5. *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} (Treatment) is the top 10% local shock indicator generated from the crops index, as described in Section 4. 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 employment and number of firms at the municipality-level across three sectors of the economy (Agricolture and Mining, Manufacturing and Non-tradable/Services). The analysis sample covers the period 1998-2014 and its construction is described in Section 3. The empirical specification is $Y_{jt} = \alpha_j + \delta_t + \beta Z_{jt} + \gamma X_{jt} + u_{jt}$, as described in Section 5. *Total Employment* is the total number of employees in the relevant sector, and *Number of Firms* is the total number of firms in the relevant sector in the municipality. All dependent variables are in logs. Z_{jt} (Treatment) is the top 10% local shock indicator generated from the crops index, as described in Section 4. 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)
	Agriculture / Mining	Manufacturing	Non-tradable/ Services
Treatment	0.116***	0.023*	0.059***
	(0.012)	(0.013)	(0.008)
Year FE	Yes	Yes	Yes
Municipality FE	Yes	Yes	Yes
Controls	Yes	Yes	Yes
Observations	71,980	66,293	80,689
Municipalities	5,161	5,086	5,443

Panel B: By Sector - Number of Firms

	(1)	(2)	(3)
	Agriculture / Mining	Manufacturing	Non-tradable/ Services
Treatment	0.018***	0.007	0.055***
	(0.007)	(0.006)	(0.005)
Year FE	Yes	Yes	Yes
Municipality FE	Yes	Yes	Yes
Controls	Yes	Yes	Yes
Observations	71,899	66,243	80,689
Municipalities	5,161	5,084	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 3. 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} (Treatment) is the top 10% local shock indicator generated from the crops index, as described in Section 4. 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	-0.608	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 3. The basic empirical specification (column 1) is $T_{ijt} = \alpha_j + \delta_t + \beta \cdot Z_{jt} + \varepsilon_{ijt}$, as described in Section 6, and where Z_{jt} (Treatment) is the top 10% local shock indicator generated from the crops index, as described in Section 4. Column 1 includes only municipality and year fixed effects. 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. *Sector* controls include dummies for seven different sectors referred to the job in year $t-1$. *Education Controls* include a binary variable for high school diploma, and a dummy variable for above high school education. *Occupation Controls* include a binary variable that equals one if previous occupation is a white collar worker, a binary variable that equals one if previous occupation is defined as generalist, a control for the type of occupation (i.e., requires non-routine cognitive skills), and a control for experience within the firm. *Wage at Previous Job* control for the rank of the individual within the wage distribution in a municipality. Column 6 includes municipality-by-year fixed effects and Sector controls. Column 7 also includes *Education*, *Occupation* and *Wage at Previous Job* controls. The dependent variable, *Founder*, is an indicator equal to 1,000 if the individual has founded a firm in year t, and 0 otherwise. Variables are defined in Section 3. 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	(7) Founder
Treatment	0.145***	0.058	0.055	0.061	0.071		
	(0.046)	(0.044)	(0.044)	(0.044)	(0.044)		
Treatment X Young		0.298***	0.304***	0.298***	0.290**	0.229***	0.25***
		(0.113)	(0.113)	(0.113)	(0.113)	(0.085)	(0.082)
Year	Y	Y	Y	Y	Y	N	N
Municipality	Y	N	N	N	N	N	N
Municipality X Young	N	Y	Y	Y	Y	N	N
Municipality X Year	N	N	N	N	N	Y	Y
Sector Controls	N	Y	Y	Y	Y	Y	Y
Education Controls	N	N	Y	Y	Y	N	Y
Occupation Controls	N	N	N	Y	Y	N	Y
Wage at previous job	N	N	N	N	Y	N	Y
Observations (mil)	23.8	23.6	23.6	23.6	23.6	23.8	23.6

Table 6
Heterogeneity Within Municipalities

This table reports the estimated effect of commodity price shocks on the probability of becoming an entrepreneur. Panel A explores individual responsiveness within the sample of young individuals in the bottom quartile of the age distribution. Panel B explores individual responsiveness within the sample of older individuals, in the top three quartiles of the age distribution. The analysis sample covers the period 1998-2014 and its construction is described in Section 3. 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 characterizing skilled versus unskilled individuals within the young population. Z_{jt} (Treatment) is the top 10% local shock indicator generated from the crops index. 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.

Panel A: Young Individuals (Bottom Age Quartile)

	(1) Founder	(2) Founder	(3) Founder	(4) Founder	(5) Founder	(6) 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

Panel B: Older Individuals

	(3) Founder	(4) Founder	(1) Founder	(2) Founder	(5) Founder	(6) 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 7
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

Table 8

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. Z_{jt} (Treatment) is the top 10% local shock indicator generated from the crops index. 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 and all controls of Table 5 Column 5. 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	0.190	0.199*	0.306	0.319***	0.062	0.042
	(0.117)	(0.115)	(0.109)	(0.108)	(0.177)	(0.175)
Treatment X Partition Variable	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	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

Appendix

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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. The model is described in the paper in Section 2. In the propositions below, 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 the magnitude of the firm entry response in the non-tradable sector,.

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 (2) and (3), it is clear that:

$$\frac{\partial l_{t,C}}{\partial P_{t,C}} > 0, \frac{\partial l_{t,T}}{\partial P_{t,C}} = 0. \tag{1}$$

From equation (5), 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 (7) that $\partial M_t / \partial F_t^* > 0$. The higher the non-pecuniary cutoff, the more entrepreneurs there are. Implicitly differentiating equation (6), we get:

$$\frac{\partial F_t^*}{\partial P_{t,C}} = \frac{-\frac{\partial \pi_{t,N}}{\partial Y_t}\frac{\partial Y_t}{\partial P_{t,C}}}{\frac{\partial \pi_{t,N}}{\partial M_t}\frac{\partial M_t}{\partial F_t^*} - 1}. \tag{2}$$

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.

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 (5), 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:

$$\frac{\alpha Y_2}{\sigma \tilde{\varphi} L_0 G(F_2^*)} > \frac{\alpha Y_2}{\sigma \varphi L_0 G(F_2^*)}. \tag{3}$$

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 (6) 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 characteristics 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 characteristics of the average entrepreneur in the Brazilian population, as discussed in Section 6.

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:

$$T_{injt} = \alpha_{nj} + \delta_{nt} + \beta_n \cdot Z_{jt} + \varepsilon_{injt}. \tag{4}$$

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 (4) on the entire population. This implies that the distribution of characteristics of responsive entrepreneurs is given by:

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

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.

Figure A.1
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.

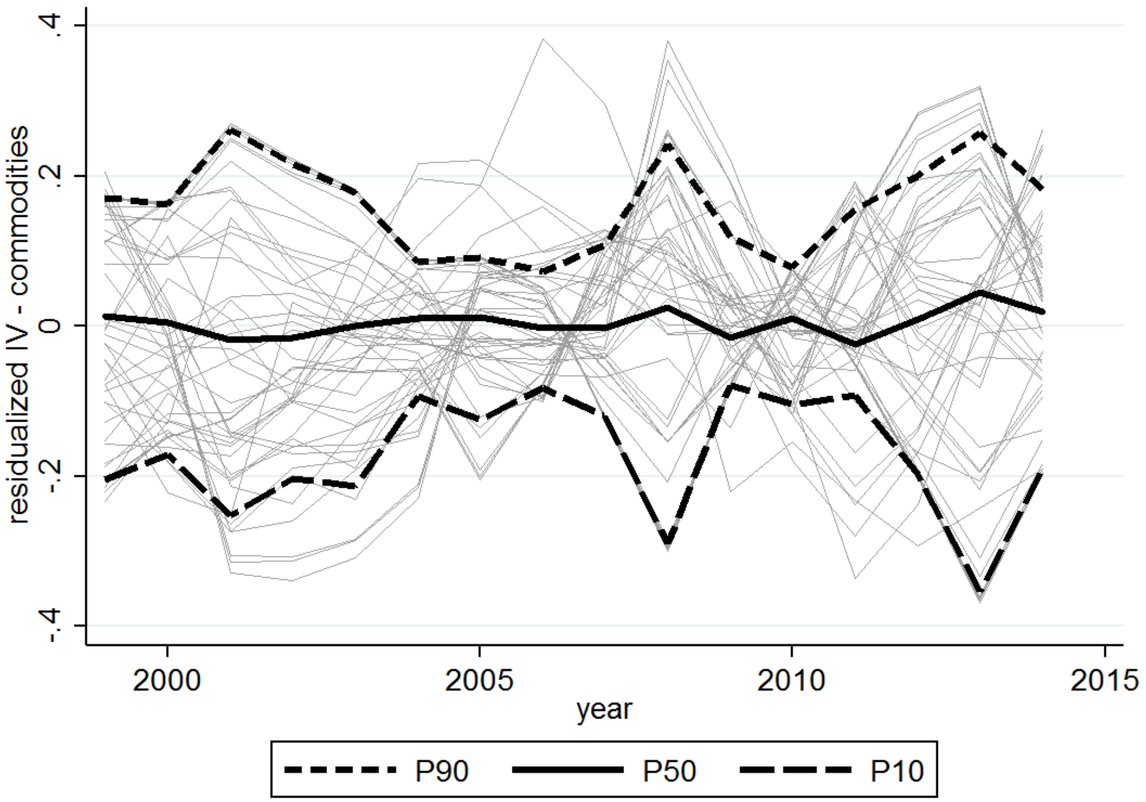

Table A.1
Agricultural Endowments Across Municipalities

This table provides a breakdown of agricultural crops and the number of municipalities in which they are being produced. We have global commodity prices prices for 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
Maize	5003
Rice	4045
Banana	3870
Orange	3763
Sugarcanes	3529
Total Coffee	2030
Soybeans	1495
Cotton	1210
Tobaccos	973
Wheat	815
Yerba mate	541
Rubber	421
Oatmeal	411
Sorghums	375
Cocoa	278
Barley	183
Indiantea	7

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 3. The empirical specification is $Y_{jt} = \alpha_j + \delta_t + \beta Z_{jt} + \gamma X_{jt} + u_{jt}$, as described in Section 5. 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 $t-1$. All dependent variables are in logs. Z_{jt} is the top 10% local shock indicator generated from the crops index, as described in Section 4. 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)
	Employment from:	
	Unemployment / Informality	Different municipality
Treatment	0.066***	0.068***
	(0.009)	(0.010)
Year FE	Yes	Yes
Municipality FE	Yes	Yes
Controls	Yes	Yes
Observations	80,456	79,630
Municipalities	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 3. The empirical specification is $Y_{jt} = \alpha_j + \delta_t + \beta Z_{jt} + \gamma X_{jt} + u_{jt}$, as described in Section 5. *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 4. 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 5.5.2.2. The analysis sample covers the period 1998-2014 and its construction is described in Section 3. The empirical specification is $Y_{jt} = \alpha_j + \delta_t + \beta Z_{jt} + \gamma X_{jt} + u_{jt}$, as described in Section 5, 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 3. The empirical specification is as described in Section 5. *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 4. 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 young 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 4. 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	0.490**	0.571**	0.418**
	(0.196)	(0.249)	(0.197)
Partition Variable	Education	Non-Routine Cognitive	Experience
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

Young Responsiveness: Robustness 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 6. The analysis sample covers the period 1998-2014 and its construction is described in Section 3. The basic empirical specification (column 1) is $T_{ijt} = \alpha_j + \delta_t + \beta \cdot Z_{jt} + \varepsilon_{ijt}$, as described in Section 6, and where Z_{jt} is either in the top 25% (specification 1), bottom 10% (specification 2), or bottom 25% (specification 4), as described in Section 4. Column 1 includes only municipality and year fixed effects. 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. *Sector* controls include dummies for seven different sectors referred to the job in year $t-1$. *Education Controls* include a binary variable for high school diploma, and a dummy variable for above high school education. *Occupation Controls* include a binary variable that equals one if previous occupation is a white collar worker, a binary variable that equals one if previous occupation is defined as generalist, a control for the type of occupation (i.e., requires non-routine cognitive skills), and a control for experience within the firm. *Wage at Previous Job* control for the rank of the individual within the wage distribution in a municipality. Column 6 includes municipality-by-year fixed effects and Sector controls. Column 7 also includes *Education*, *Occupation* and *Wage at Previous Job* controls. The dependent variable, *Founder*, is an indicator equal to 1,000 if the individual has founded a firm in year t, and 0 otherwise. Variables are defined in Section 3. Standard errors are clustered by municipality. *,**, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Founder	Founder	Founder	Founder	Founder	Founder	Founder
Specification 1							
Top 25%	0.066**	0.004	0.0012	0.00539	0.014		
	(0.032)	(0.031)	(0.0308)	(0.0308)	(0.0311)		
Top 25% X Young		0.227***	0.231***	0.231***	0.220***	0.207***	0.150***
		(0.077)	(0.077)	(0.077)	(0.077)	(0.061)	(0.057)
Specification 2							
Bottom 10%	-0.093**	-0.031	-0.029	-0.034	-0.049		
	(0.042)	(0.042)	(0.042)	(0.042)	(0.042)		
Bottom 10% X Young		-0.231**	-0.231**	-0.234**	-0.229**	-0.148*	-0.201**
		(0.109)	(0.109)	(0.109)	(0.109)	(0.081)	(0.077)
Specification 3							
Bottom 25%	-0.077***	-0.022	-0.021	-0.025	-0.037		
	(0.028)	(0.029)	(0.029)	(0.029)	(0.029)		
Bottom 25% X Young		-0.21***	-0.211***	-0.213***	-0.205***	-0.216***	-0.217***
		(0.071)	(0.071)	(0.071)	(0.071)	(0.056)	(0.053)
Year	Y	Y	Y	Y	Y	N	N
Municipality	Y	N	N	N	N	N	N
Municipality X Young.	N	Y	Y	Y	Y	N	N
Municipality X Year	N	N	N	N	N	Y	Y
Sector	N	Y	Y	Y	Y	Y	Y
Education Controls	N	N	Y	Y	Y	N	Y
Occupation Controls	N	N	N	Y	Y	N	Y
Wage at previous job	N	N	N	N	Y	N	Y
Observations (mil)	23.8	23.6	23.6	23.6	23.6	23.8	23.6

Table A.8

Young Responsiveness: Attrition - Alternative Definitions

This table reports the estimated effect of commodity price shocks on the probability of becoming an entrepreneur, where we consider vary the definition of entrepreneur to account for attrition. The analysis sample covers the period 1998-2014 and its construction is described in Section 3. The basic empirical specification (column 1) is $T_{ijt} = \alpha_j + \delta_t + \beta \cdot Z_{jt} + \varepsilon_{ijt}$, as described in Section 6, and where Z_{jt} (Treatment) is the top 10% local shock indicator generated from the crops index, as described in Section 4. Column 1 includes only municipality and year fixed effects. 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. *Sector* controls include dummies for seven different sectors referred to the job in year $t-1$. *Education Controls* include a binary variable for high school diploma, and a dummy variable for above high school education. *Occupation Controls* include a binary variable that equals one if previous occupation is a white collar worker, a binary variable that equals one if previous occupation is defined as generalist, a control for the type of occupation (i.e., requires non-routine cognitive skills), and a control for experience within the firm. *Wage at Previous Job* control for the rank of the individual within the wage distribution in a municipality. Column 6 includes municipality-by-year fixed effects and Sector controls. Column 7 also includes *Education*, *Occupation* and *Wage at Previous Job* controls. The dependent variable, *Pre-Founder*, is an indicator equal to 1,000 in year t if the individual has founded a firm prior to, and including, year t and that firm is still alive in year t, and 0 otherwise. The dependent variable in Panel B, *Pre-Founder*5, is a variable equal to 1,000 in year t if the individual has founded a firm in the prior 5 years, and including, 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.

Panel A: Replacing the Dependent Variable - Ever Founder

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Pre-Founder	Pre-Founder	Pre-Founder	Pre-Founder	Pre-Founder	Pre-Founder	Pre-Founder
Treatment	0.438**	0.125	0.124	0.161	0.316*		
	(0.178)	(0.158)	(0.158)	(0.158)	(0.167)		
Treatment X Young		0.951***	0.957***	0.975***	0.867***	1.19***	1.08***
		(0.321)	(0.321)	(0.321)	(0.318)	(0.263)	(0.304)
Year	Y	Y	Y	Y	Y	N	N
Municipality	Y	N	N	N	N	N	N
Municipality X Young	N	Y	Y	Y	Y	N	N
Municipality X Year	N	N	N	N	N	Y	Y
Sector	N	Y	Y	Y	Y	Y	Y
Education Controls	N	N	Y	Y	Y	N	Y
Occupation Controls	N	N	N	Y	Y	N	Y
Wage at previous job	N	N	N	N	Y	N	Y
Observations (mil)	23.8	23.6	23.6	23.6	23.6	23.8	23.6

Table A.8
(Continued)

Panel B: Replacing the Dependent Variable - 5 Year Founder

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Pre-Founder5	Pre-Founder5	Pre-Founder5	Pre-Founder5	Pre-Founder5	Pre-Founder5	Pre-Founder5
Treatment	0.396***	0.171	0.167	0.191*	0.306**		
	(0.128)	(.112)	(.112)	(.112)	(.119)		
Treatment X Young		0.690**	0.699**	0.711**	0.794***	0.771***	0.769***
		(0.277)	(0.277)	(0.276)	(0.275)	(0.258)	(0.224)
Year	Y	Y	Y	Y	Y	N	N
Municipality	Y	N	N	N	N	N	N
Municipality X Young	N	Y	Y	Y	Y	N	N
Municipality X Year	N	N	N	N	N	Y	Y
Sector	N	Y	Y	Y	Y	Y	Y
Education Controls	N	N	Y	Y	Y	N	Y
Occupation Controls	N	N	N	Y	Y	N	Y
Wage at previous job	N	N	N	N	Y	N	Y
Observations (mil)	23.8	23.6	23.6	23.6	23.6	23.8	23.6

Table A.9
Young Responsiveness: Attrition - Additional Controls

This table reports the estimated effect of commodity price shocks on the probability of becoming an entrepreneur, where we control for previous experience as entrepreneur. The analysis sample covers the period 1998-2014 and its construction is described in Section 3. The basic empirical specification (column 1) is $T_{ijt} = \alpha_j + \delta_t + \beta \cdot Z_{jt} + \varepsilon_{ijt}$, as described in Section 6, and where Z_{jt} is the top 10% local shock indicator generated from the crops index, as described in Section 4. Column 1 includes only municipality and year fixed effects. 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. *Sector* controls include dummies for seven different sectors referred to the job in year $t-1$. *Education Controls* include a binary variable for high school diploma, and a dummy variable for above high school education. *Occupation Controls* include a binary variable that equals one if previous occupation is a white collar worker, a binary variable that equals one if previous occupation is defined as generalist, a control for the type of occupation (i.e., requires non-routine cognitive skills), and a control for experience within the firm. *Wage at Previous Job* control for the rank of the individual within the wage distribution in a municipality. Column 6 includes municipality-by-year fixed effects and Sector controls. Column 7 also includes *Education*, *Occupation* and *Wage at Previous Job* controls. The variable *Previously Founder* in Panel A, is equal to 1 in year t if the individual has founded a firm prior to year t, and 0 otherwise. The variable *Previously Founder (5yr)* in Panel B, is equal to 1 in year t if the individual has founded a firm in the five years prior to year t, and 0 otherwise. Standard errors are clustered by municipality. *,**, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

Panel A: Controlling for Past Experience - Ever Founder

	(1) Founder	(2) Founder	(3) Founder	(4) Founder	(5) Founder	(6) Founder	(7) Founder
Treatment	0.144***	0.058	0.055	0.059	0.071		
	(0.046)	(0.044)	(0.044)	(0.044)	(0.044)		
Treatment X Young		0.297***	0.302***	0.304***	0.291**	0.225***	0.249***
		(0.113)	(0.113)	(0.113)	(0.113)	(0.085)	(0.082)
Previously Founder	0.004***	0.002***	0.002***	0.002***	0.001***	0.003***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Year	Y	Y	Y	Y	Y	N	N
Municipality	Y	N	N	N	N	N	N
Municipality X Young	N	Y	Y	Y	Y	N	N
Municipality X Year	N	N	N	N	N	Y	Y
Sector	N	Y	Y	Y	Y	Y	Y
Education Controls	N	N	Y	Y	Y	N	Y
Occupation Controls	N	N	N	Y	Y	N	Y
Wage at previous job	N	N	N	N	Y	N	Y
Observations (mil)	23.8	23.6	23.6	23.6	23.6	23.8	23.6

Table A.9
(Continued)

Panel B: Controlling for Past Experience - 5 Year Founder

	(1) Founder	(2) Founder	(3) Founder	(4) Founder	(5) Founder	(6) Founder	(7) Founder
Treatment	0.143***	0.057	0.055	0.058	0.069		
	(0.045)	(0.044)	(0.044)	(0.044)	(0.044)		
Treatment X Young		0.296***	0.302***	0.303***	0.289**	0.223***	0.247***
		(0.113)	(0.113)	(0.113)	(0.113)	(0.085)	(0.082)
Previously Founder (5yr)	0.005***	0.003***	0.003***	0.003***	0.002***	0.005***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Year	Y	Y	Y	Y	Y	N	N
Municipality	Y	N	N	N	N	N	N
Municipality X Young	N	Y	Y	Y	Y	N	N
Municipality X Year	N	N	N	N	N	Y	Y
Sector	N	Y	Y	Y	Y	Y	Y
Education Controls	N	N	Y	Y	Y	N	Y
Occupation Controls	N	N	N	Y	Y	N	Y
Wage at previous job	N	N	N	N	Y	N	Y
Observations (mil)	23.8	23.6	23.6	23.6	23.6	23.8	23.6

Table A.10
Aggregate Results by Age Quartile

This table reports the estimated effect of commodity price shocks on income and employment at the municipality level for four quartiles of the age distribution. The analysis sample covers the period 1998-2014 and its construction is described in Section 3. The empirical specification is $Y_{jt} = \alpha_j + \delta_t + \beta Z_{jt} + \gamma X_{jt} + u_{jt}$, as described in Section 5. *Total Employment* is the total number of employees in each municipality in the specified age group, *Total Income* is the sum of payroll across all firms paid to employees in the specifiied age group. All dependent variables are in logs. Z_{jt} (Treatment) is the top 10% local shock indicator generated from the crops index, as described in Section 4. 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 Age Quartile - Employment

	(1)	(2)	(3)	(4)
	Total Employment Q1	Total Employment Q2	Total Employment Q3	Total Employment Q4
Treatment	0.053***	0.058***	0.072***	0.062***
	(0.008)	(0.007)	(0.007)	(0.007)
Year FE	Yes	Yes	Yes	Yes
Municipality FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Observations	80,604	80,747	80,761	80,709
Municipalities	5,443	5,443	5,443	5,443

Panel B: By Age Quartile - Total Income

	(1)	(2)	(3)	(4)
	Total Income Q1	Total Income Q2	Total Income Q3	Total Income Q4
Treatment	0.055***	0.071*	0.085***	0.074***
	(0.009)	(0.008)	(0.008)	(0.007)
Year FE	Yes	Yes	Yes	Yes
Municipality FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Observations	80,604	80,747	80,761	80,709
Municipalities	5,443	5,443	5,443	5,443