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Spice Price Spikes: Simulating Impacts of Saffron Price Volatility in a Gendered Local Economy-Wide Model

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Summary. — Access to international markets provides smallholders with unprecedented opportunities, but also exposes them to world market whims. We use a local economy-wide impact evaluation (LEWIE) model to analyze how the recent global saffron-price variability affected Morocco's Taliouine–Taznakht region, a specialized agro-export economy with a stark gender division of labor. Prices of saffron increased by 71% per year over the 2007–09 period before falling quickly back to their trend. Our modeling approach allows us to simulate such shocks and evaluate impacts not only on producers but also on the local economies around them. In our simulations, positive price-shocks and increases in productivity both cause large reallocations of labor resources, particularly for female workers at harvest time. We use Monte-Carlo simulations to evaluate how saffron-price variance affects the economy. Female wage income is especially sensitive to global price variability: a 100% increase in saffron-price variance leads to 133% increase in female wage income variance, but only 36% for males. Accounting for general-equilibrium effects is critical for understanding the ramifications of exposure to export price volatility in poor economies.

Key words — impact evaluation, price volatility, gender, market integration, Africa, Morocco

1. INTRODUCTION

The international market for high-value boutique food products has exploded in recent years. Innovations in certification programs (e.g., fair trade, organic), policy emphasis on value chain approaches to growth in agro-food sectors, widespread NGO support for interventions to improve smallholder profitability, and aggressive marketing by both general and specialty retail chains have combined to create an unprecedented proliferation of differentiated and specialized products from around the world in European and North American markets. Entire aisles in many supermarkets are now dedicated to these boutique food products, which can often be traced to development efforts linking smallholder producers to high-value international markets. Integration with specialty export markets opens up new economic opportunities, but it also exposes producers and the economies of which they are part to the whims of international markets and price volatility. Absent insurance or other interventions to smooth prices, local economies have to adjust to recurring price shocks.

We study the impacts of global saffron price volatility on a saffron-producing economy in Morocco, using unique micro-household data and local economy-wide modeling methods (Taylor & Filipski, 2014). The model we use could be applied to any smallholder cash-crop producing rural economy, but saffron and rural Morocco provide an emblematic case. Taliouine–Taznakht is a specialized agro-export economy heavily dependent on world markets it cannot influence. Production involves a very labor-intensive process (saffron harvesting), and female wage workers constitute a well-defined group of stakeholders that depends almost exclusively on saffron employment for income. These stark features make it an ideal case to study how impacts of price volatility ripple through an economy by way of general-equilibrium effects, and how different actors are exposed to those effects. Further, the recent fluctuations in the price of saffron have been vertiginous.

From 2006 to 2009, the international saffron price more than tripled then collapsed back to its historical average faster than it had risen—a pattern mirrored in saffron prices in rural Morocco. While food prices spiked worldwide during this same period, the factors driving the saffron market are distinct from those driving general food markets. Iran produces the vast majority of the world's saffron, and Spanish wholesalers control much of the international saffron trade. Together, this market power at the production and wholesale levels shapes the international saffron market. Poor production in Iran in the late 2000 s appears to be the main cause of the saffron price spike (Dubois, 2010).

In Taliouine–Taznakht, saffron represents 70% of farm income, and 40% of all income (Aboudrare *et al.*, 2014). Beyond the farmers themselves, the workers they hire and the traders they buy goods and services from are all deeply affected by the saffron economy. High prices were seen as a huge opportunity and triggered significant investment in the sector (in particular in enhanced irrigation technology, as

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water is by far the largest constraint to production).[1] However, the boon did not last.

A boom and bust of unprecedented magnitude can have major consequences for rural livelihoods in saffron-producing regions. A pronounced and rapid appreciation of saffron prices for three consecutive years is likely to lead farmers to shift toward saffron production. One would expect a price collapse to have the opposite effect. Meanwhile, local economy-wide linkages transmit the impacts of the price boom/bust from saffron-producing households to others within the local economy. The prices of local goods and services, the wage rate, the rental rate on land, are all intimately linked to saffron prices. Thus volatility in the price of the spice can translate into instability throughout the local economy.

Inter-temporal linkages transmit impacts across seasons, as well. Saffron, the dearest spice in the world, is produced by cultivating saffron crocus flowers (*crocus sativus*), painstakingly removing their stigmas, and carefully drying them. In this sequential production process, the value of flowers is a derived value linking the harvest and pre-harvest seasons. In the mountainous region of Taliouine–Taznakht in Morocco, cultivation is a male-dominated activity, while women are almost exclusively responsible for the tedious process of harvesting the flowers and delicately removing the crocus stigmas—work that must be accomplished in a very compressed and intense timespan of a few weeks.[2]

Because of the structure and gender division of labor in traditional saffron production, international market shocks potentially affect gender and intra-household dynamics. A high demand for female wage labor at harvest time may divert women from the non-market activities they traditionally perform, including child rearing and housework. The demand for female labor in these domestic activities, in turn, may constrain the saffron-supply response to higher world prices, in much the same way that missing product markets limit market supply response in agricultural household models (de Janvry *et al.*, 1991; Taylor & Adelman, 2003).[3]

Pronounced and rapid appreciation (or depreciation) of saffron prices potentially has far-reaching impacts in a region that depends heavily on saffron production for cash income. Saffron provides wage work opportunities for many, and for most women saffron harvesting is the only option for cash income. Saffron prices influence the incomes, but also the expenditures, of farmers and farm workers. Local businesses thrive or fail with the saffron economy. Combined, the rapid succession of a boom and bust of unprecedented amplitude represents a dizzying shift in incentives for the local economy, and they raise the question of how changes in the distribution (not just level) of prices impact a poor agricultural export economy. The extent to which markets can adjust to the shocks will determine how different actors are affected by these shifts.

The question of smallholder integration to world markets has been researched extensively in the economic literature. Economists have studied how participation in cash crop markets can provide smallholders a pathway out of poverty: growing tobacco in Malawi (Orr, 2000) or fair trade certified coffee in Nicaragua (Bacon, 2005) or pineapples in Ghana (Takane, 2004) have all shown potential to generate positive impacts on farmers. On the other hand, the vulnerability induced by dependency on the mainstream markets was also pointed out (Valkila, 2009). Whether world markets are more or less volatile than domestic markets will shape the impact economic opening (Winters, 2002). The role of risk in smallhoders' decision to engage in cash crop production or not is also well-understood (Fafchamps, 1992). But while the opportunities and risks related to cash crop production by smallholders have been well documented both theoretically and empirically, a majority of this research focuses on producer households alone and pays little attention to spillovers and general equilibrium effects. By adopting an economy-wide perspective, our research sheds light on the economic linkages that transmit world market shocks beyond smallholders themselves and provides a consistent framework to assess them. Our focus on volatility is, as far as we know, unique within the local economy-wide modeling literature. Finally, by distinguishing labor by gender we are able to highlight the differential vulnerability to price-volatility of male and female workers when labor markets are segregated.

We design a local economy-wide impact evaluation (LEWIE) model to uncover the impacts of global saffron price variability on the rural economy and the role of general-equilibrium adjustments in transmitting this variability to local economic outcomes. It extends the model described in Taylor and Filipski (2014) to analyze impacts of price shocks. Our model is tailored to the specificities of the saffron production process, in particular, a highly seasonal and gender-biased labor demand. It also incorporates the non-monetized economy, which represents a substantial burden on the time use of women in the region. To our knowledge, this is the first attempt to formally model the local economy-wide impacts of an agricultural export price boom and the first to capture seasonal linkages in a LEWIE model. We use the model to evaluate the transmission of impacts of the saffron-price boom and bust through the local economy, across seasons and households, and between genders. We simulate the impacts of three types of shocks to the economy observed in recent years in Taliouine–Taznakht: (1) a saffron price shock (increase or decrease), (2) investments in saffron production-enhancing technology, and (3) an increase in the variance of the saffron price distribution.

Our simulation findings reveal that an increase in the global price of saffron leads to a significant reallocation of labor to saffron production in both the cultivation and harvest seasons. It stimulates the labor market, as larger producers hire workers from smallholder households. Workers of both genders are put to work, but males are disproportionately affected in the cultivation season and females at harvest time. Women's time devoted to childcare and other reproduction activities falls at harvest time and increases in the cultivation period. Increases in flower yields create labor bottlenecks at harvest time, resulting in a high demand for female labor to process flowers. Increasing volatility of saffron prices has different impacts on the variability of factor use, production, and incomes. Households are able to buffer the extent to which saffron-price variability translates into income variability, but with high amplitudes in factor-use and production responses. Wage incomes of females are much more volatile in the face of saffron price variability than wage incomes for males.

2. BACKGROUND AND THEORY

(a) *Saffron production*

The saffron crocus can grow under a relatively wide range of climates; however, production of good quality saffron requires specific conditions: soils cannot be too humid or too fertile, rain cannot fall during the flowering season, and temperatures must remain high (Madan, Kapur, & Gupta, 1966). The region of Taliouine, Morocco, has produced saffron for centuries, but it is a more recent crop for the neighboring region

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