

Cultural Identity, Human Development and Entrepreneurship in Singapore: A Longitudinal Household Data*

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Abstract

This paper proposes a data development architecture and delineates the associated research initiative, with the goal of generating high-quality microeconomic survey data at household level in Singapore. We aim to facilitate policy analysis and academic research into the way in which households use residential real estate, human capital and financial instruments to attain their lifetime objectives, contributing to an inclusive society and sustainable economic growth. We propose a holistic approach, distinguished by a focus on cultural identity, human capital and entrepreneurship, and driven by newly available technical solutions that allow for data retrieval in real time.

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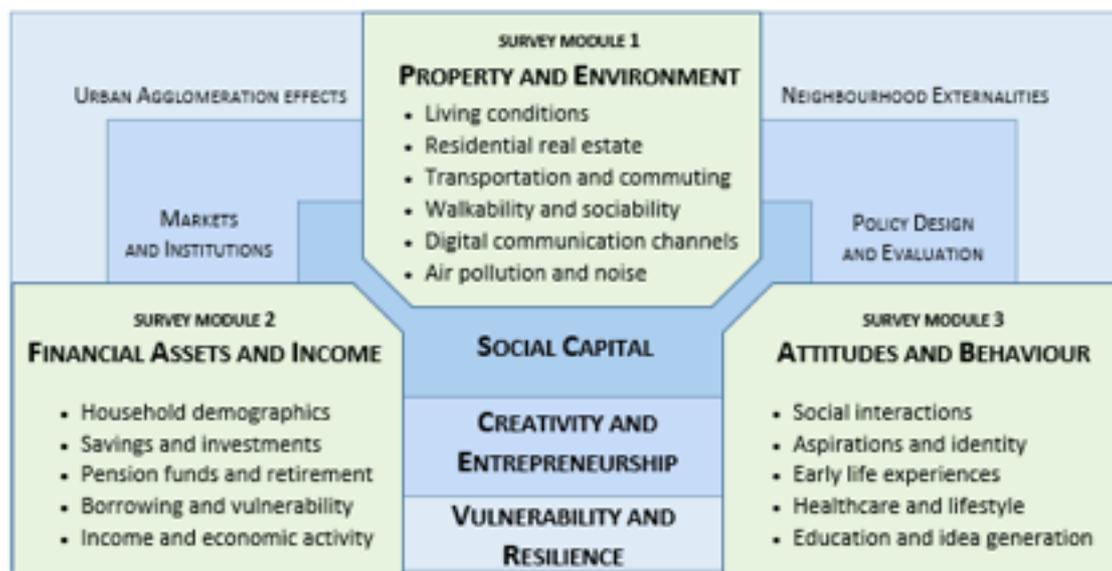
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The project aims to bridge a gap in integrated household-level data on urban externalities in Singapore, with a focus on cultural identity, human development and entrepreneurship. In particular, we aim to address and enrich a strand of the academic literature that has gained momentum in recent years: the data-driven evidence-based analysis of public policies.

A major challenge to social science research, and especially policy analysis, is the identification of causation instead of correlation. The endogeneity of independent variable due to omitted variables, or two-way causality, may lead to spurious correlations between the independent and dependent variables even in the absence of a causal relationship. Common work-arounds to deal with the endogeneity issue include quasi-exogenous shocks to the independent variable (e.g., Agarwal et al. 2016; Ahlfeldt et al. 2015; Davis and Weinstein 2002; Deng et al. 2013; Hornbeck and Keniston 2014; Siodla 2015; Fu and Shi 2016), identifying appropriate counterfactuals of the treated units (e.g., through the difference-in-differences approach), and implementing randomized experiments (e.g., randomized control trials, RCTs).

Our proposed data framework development will allow us to deal with the endogeneity problem in two main ways. First, we collect the respondent's major life shocks and events on a monthly basis to understand the effect of such shocks on individual behaviours and social interactions. For example, how does an earthquake in Japan affect an individual's insurance take-up decision (see Zhu et al. 2016)? Second, we propose a framework to carry out randomized control trials during the data collection process. Such practice is especially useful for policy makers to experiment with new urban policies and directly evaluate the effectiveness of policies.

Figure 1: Survey structure



We seek to link households, the urban environment and the local economy, to enable more powerful analysis of economic and urban challenges. Previous comparable surveys do not cover Singapore and face difficult technical trade-offs between study depth and population coverage. We propose a modular survey structure (see Figure 1) that has become popular around the world during the recent years. This is based on three components, capturing (a) the household balance sheet and economic activity, (b) the characteristics of the residential

property and living conditions, as well as (c) the household's aspirations, behaviour and social network.

Phase 1 consists of traditional survey methods. We can hereby draw upon a significant pool of experience in survey design and implementation, leading to international comparability and reduced initial costs. Households are selected to be representative of the overall resident population. They are interviewed by trained personnel (e.g. university students), who check the relevant documentation (e.g. property deeds, bank account statements, company records), assess the reliability of responses and enforce consistency across questions.

Phase 2 consists of an app-based mobile solution, which households are trained to use during the initial survey interview.

The advantages of such a solution include:

- 1) Convenience for the respondents to record their activities in any occasion.
- 2) A lower attrition rate compared with paper-based survey due to better tractability.
- 3) Possibilities to synchronise information from other apps with permission from the respondents.
- 4) Opportunities to generate randomized information to serve as treatments from which we observe behavioural responses.

The post-interview interaction with the app should have both a dimension of regularity – such as recording changes in different elements of the survey modules every month or quarter, and a degree of trigger-based activation – such as recording significant events (either private or environmental, e.g. employment status, health conditions, traffic disruptions, or impairment due to haze).

C. NOVEL DATA COLLECTION METHODS

Most people live busy lives, filling their days with a wide range of activities and experiences. While retrospective questions in traditional surveys have been the typical method to measure these experiences, they suffer from a number of weaknesses, most notably the inability of people to accurately recall the minute details of what they do and the way they interpreted those experiences. As smartphones are becoming more popular nowadays, the smartphone-based app method is likely to emerge as the benchmark approach to collect survey data.

There are several advantages to use smartphone based apps. First, smartphone are characterized by easy accessibility and high mobility, as they are always carried by their owners. This relieves the economical and practical burden of submitting the survey results. Furthermore, the apps can run as long as the smartphone is on and can provide valuable real-time information. Third, the sensor embodied in the smartphone easily captures information such as location, WiFi signal etc., which can provide the opportunity for more sophisticated studies.

The apps-based survey is emerging as popular data collection tools to investigate the human behaviour during recent years. In general, the relevant studies can be categorized as follows:

- (1) Collecting the individual's location data to understand the travel behaviour;
- (2) Monitoring the network signal to mapping the signal strength of mobile operators and build internet topology;
- (3) Measuring phone's battery usage and the running apps to provide energy efficient suggestion;
- (4) App-based surveys to easily collect the household census and other research information;
- (5) Detecting a fall even and elder's mobility to help improve their quality of life;
- (6) Environmental data collection such as noise and air pollution.

Some apps require sensors such as the accelerometer (1 and 5), GPS (2 and 6), microphone (6), while some do not (3 and 4). Depending on the experiment design, some apps are non-instructive since they run at background (2 and 3), while some may need users to provide short post-reports (1 and 5).

HOUSEHOLD TRAVEL SURVEYS

The Future mobility survey (FMS, see Zhao et al. 2015) was developed and field-tested in Singapore in conjunction with the Singapore Land Transport Authority's (LTA's) Household Interview Travel Survey (HITS) 2012. The results help LTA understand the household travel pattern.

The app collects the individuals' spatial information, stops, travel modes and non-travel activities for a typical weekday (GPS location and speed information). It also collects the socio-demographic characteristics of the households and the individuals. The format of the survey follows the standard trip diary-based approach, with travel defined as a one-way journey completed for a purpose.

This approach has a number of advantages: accurate and efficient information, non-intrusiveness, low cost, higher trip reporting rates, higher completion rate. On the downside, we note battery consumption, user-friendliness/intuitiveness of the interface, and extensive machine learning to improve data quality.

The goal is hereby to prompt respondents to answer these in-app survey questions in close to real-time at each trip destination and in a very low burden way, which facilitates the ability to conduct these projects for the longer data collection period.

Similar travel surveys have been conducted in the USA, Czech Republic, Germany, Australia, and New Zealand, with experimental designs being broadly consistent across these countries.

In the USA, the UbiActive application monitors travel behaviours and physical activities (Fan et al, 2013). Surveys record the completion of a trip and report the purpose and feedback. Similarly, the In the Moment (ITM) Travel Study project was conducted on behalf of the Madison County Council of Governments (MCCOG) in Anderson, Indiana and the Federal Highway Administration (FHWA) Office of Planning and Office of Transportation Policy Studies (see Greene et al. 2016). 478 people from 288 households used smartphone GPS data collection over a seven-day period. The smartphone's sensors passively collected location data (the "where and when" of travel data), while in-app survey questions obtain the remaining essential HTS data elements (the "why, who, and how" of travel behaviour).

In Europe, recent smartphone-based GPS travel surveys have included a 2013-2014 travel survey of 1,000 participants across the Czech Republic who answered a questionnaire, were then provided with an Android™ smartphone for a two-week data collection period, and additionally completed paper travel diaries in parallel to carrying the smartphone (see Kouril et al. 2014).

In 2013, the Dutch Mobility Panel implemented a smartphone app called MoveSmarter where 600 panel 14 members participated for a two week period (see Geurs et al. 2014). Among the 600 participants, approximately 40% used their own smartphones while the rest were provided with new devices. All of them were asked to use a web-based prompted-recall survey. Preliminary results indicate higher trip rates than previous traditional survey methods.

In Sydney, Australia, a seven-day travel diary was conducted in 2013 with more than 600 participants (see Greaves et al. 2014). About half of participants used their own smartphones to passively record travel patterns over a period of seven days and then verified their trip details in an online diary where they could view maps of their daily travel.

Finally, in New Zealand, a 2014 trial of the national Household Travel Survey was recently conducted to compare methods among web-based, handheld GPS, and Android™ droid smartphone-based GPS survey approaches. A total sample of 70 participants have completed the survey (see Safi et al. 2014).

NETWORK CONNECTIVITY

Smartphone-based data collection also fosters the rise of radically novel systems and applications in the context of network monitoring. Purpose-designed apps collect the individual's network signal strength and internet address (see Faggiani et al. 2014). Approximately 100 individuals participated in the study and the app provides the signal strength of mobile operator's information several times each day. In six months, more than 800,000 signal strength samples have been collected.

The advantages of network monitoring are that it shortens the completion time by dividing a large task into a set of small and loosely coupled micro-tasks, with less economical and practical burden and good performance due to the features of the smart-phone based app (high mobility, real-time update, upgrade ease etc). The downsides concern battery consumption, bandwidth-limited, participants' motivation and incentives problems, security and privacy issues.

For telecom operators, signal coverage maps allow for the fine tuning of the wireless access infrastructure. The signal strength in a given point changes dramatically with the different operators, which makes a detailed map useful for the end users. They can select the operator providing the best quality where they spend the most of their time. There are a lot crowd sourcing-based systems in networking, however it seems to belong to the computer science field.

ENERGY USE SURVEYS

Mobile battery awareness applications are also used to provide a unified view of the energy state of the mobile device (see Peltonen et al. 2015).

The app captures battery information across a wide range of usage contexts and devices. The data includes information about the device's operating system and model, the current battery level, the set of currently active applications, and information about different system settings such as network connections and screen brightness and subsystem variables such as the CPU use and the distance travelled since the last measurement. Such studies include Athukorala et al (2014), Oliner et al (2013) and Ding et al (2013). The advantages are the cost-effectiveness, accuracy, and non-obtrusive instrumentation. The downsides are the complex algorithm and computational model requirements.

SURVEYS OF DAILY ACTIVITIES

Alternatively, experience sampling methodology and daily diary (ESM/DD) approaches are used to investigate the individual or organizational behaviour in a response-driven way. Since they elicit repeated reports of immediate or very recent experiences from the same sample of people for several days or weeks, we could implement this kind of research with phone apps-based daily survey. Cell phones have been used for the study by Andrews et al. (2011) and Berkman et al. (2011): the survey instrument can be saved in participants' own phones by using the phone's wireless application protocol. Signals can be embedded in the program or sent via SMS. Participants open and complete the survey when signalled, and responses are sent directly to the researchers.

The research field includes thoughts and attitudes such as job satisfaction, goals, recovery, moods, emotions, and intrinsic motivation/engagement/flow; behaviours and outcomes including coping behaviour, effort, creativity, performance, emotional expression, citizenship behaviour, and counterproductive work behaviour; and fluctuating environmental situations and demands such as social interactions, workload, task characteristics, work-family conflicts, and other stressors.

COMMUNITY DEVELOPMENT SURVEYS

With the help of an apps-base survey, community health workers with little experience of data collection could be trained and successfully supervised to collect data using mobile phones in a large baseline survey, especially in developed countries (see Tomlison et al., 2009). The project concerns a household census in Umlazi, South Africa. Survey data are

uploaded using low cost general packet radio service, id, household code, location, and house appliance. Over the course of four months, 39,665 households were surveyed with no data loss. The main gains concern cost effectiveness and the potential implementation possibilities in rural areas, while problems can appear with respect to data security and respondent confidentiality.

HEALTHCARE SURVEYS

An app can meet the needs and requirements of older users to help them improve their mobility and quality of life (see Berkman et al. 2011). The app can detect fall event in the real-time and its subsequent management mobility: it measures the time taken by an individual to stand up from a chair, walk 3 meters, return to the chair and sit down. When a fall is detected, an audio notification is generated for 30 seconds to verify the subject response. During this time the subject can press a “Stop Alert” button to stop the notification and to disable the external alarm procedure. If the subject does not react to the audio notification, and is hence supposedly unconscious, an alarm is automatically sent to the caregivers (by e-mail and/or SMS) to start the assistance procedures.

The substantial advantages are that this process is user friendly and can even contribute to improve health care. On the downside, care should be taken when interpreting the data because of the classification details of fall types; necessary cross-checks and the need to implement additional mobility-oriented and fall-oriented applications on Smartphone device, small sample sizes and selected samples. Nevertheless, these issues are particularly relevant in an aging society, in order to assess functional balance and mobility.

CROWDSOURCING

This line of research is particularly encouraged by the substantial success of crowdsourcing during recent years, which also holds promise for progress in the future. Notable examples of crowdsourcing systems include:

- 1) Amazon’s Mechanical Turk: users operate as computing elements to perform those tasks that cannot be easily automated through machines, such as identifying elements within images or transcribing audio clips.
- 2) OpenStreetMap: users contribute GPS tracks, collected with their personal devices, to build and update a free and open map of the world.
- 3) InnoCentive: a platform for corporate research where scientific problems are posted by companies to be studied by crowds of possible solvers.
- 4) The road traffic overlays that can be displayed on Google and Apple maps: a large number of devices report their GPS location and speed information, after being anonymized and encrypted, to the companies’ servers where these data are aggregated and then again delivered to map applications on mobile terminals.

The ideas behind crowdsourcing encompass a wide range of applications and are characterized by different business models. For instance, just limiting the analysis to the few examples above, in some cases users are rewarded with money (1 and 3), whereas in other cases the model relies on the contributions of non-professional users (2 and 4). The amount of work to be carried out by the single worker can be significant (as in 3) or very small (1, 2 and 4), thus relying on the aggregate power of large numbers. In the last years smartphones and other portable devices fueled the rise of crowd sensing, where participants contribute to data produced by the sensors and other equipped devices to collect side images, audio, and pollution levels. Useful guides to the advantages and potential challenges of crowdsourcing are found in the work of Howe 2008, Brabham 2008, Doan et al 2011, Ganti et al. 2011.

D. FOCUS: SINGAPORE

In Singapore, the issues of urban interactions, human capital development, social inclusion and entrepreneurship have particular relevance. So far, a number of distinct initiatives have addressed different aspects.

One prominent example is the Institute of Policy Studies (IPS) Household Survey. Conducted between December 2012 and April 2013, it surveyed 4,131 Singaporean residents (mostly citizens) and examined the factors contributing to their sense of identity. Through questions on subjective opinions and attitudes by demographics, race, religion, and language, it is found that Singaporeans' identity is strongly linked with race, religion, and language. Public morality is not easily disengaged from religious beliefs and values.

Another local household survey is the National Orientations of Singaporeans Survey (NOS4) in 2010, which includes 2,016 interviews between February 2009 and May 2009. Specifically, it constructs indexes on national loyalty, national pride, political alienation, social provision, and sense of community, tracking the involvement over time. It is revealed that the sense of national loyalty and pride is stable with declined political alienation. A survey specifically targeting at the youth is also implemented (Survey on Emigration Attitudes of Young Singaporeans), taking a prospective approach to study their emigration attitudes and rootedness. In addition to factors affecting the intention to emigrate, the survey results indicate that the anchors to Singapore are the quality of relations with friends, family members and home ownership. Equally important are the equal opportunities, safety and security.

With regard to a specific life event, the National Service, IPS conducted a survey on Singaporeans' Attitudes to National Service (2013), and finds strong public support for the National Service. Singaporeans see National Service fulfilling a social mission beyond its defence mandate. Men of all ages have mainly positive view of the service.

As more than 80% of the population living in the Housing and Development Board (HDB) flats, their satisfaction toward the environment and neighbourhood is a crucial part for social inclusion. More than 91 percent of HDB households were surveyed in the Sample Household Survey in 2013, with 92% expressed satisfaction with their neighbourhood. The main concern lies in inconsiderate neighbours. The survey also breaks down into sub-population, such as elderly residents (with the majority indicating desire to age-in-place) and married children who are more likely living near or with their parents.

Last but not least, the Study on Chinese, Malay and Tamil Blogospheres in Singapore, for the first time, examines non-English language blogospheres (Chinese, Malay, and Tamil languages). It shows that the online space is a richly diverse one. Locals make up the majority in the Chinese and Malay language blogospheres while long-term non-Singapore-born residents dominate the Tamil language blogosphere.

E. RESEARCH FOCUS

Compared to currently available survey data, we propose a holistic approach capturing financial conditions, corporate behaviour, residential real estate and individual attitudes. In addition, the intensive use of new technical solutions (e.g. a mobile app) will allow us to survey households more frequently and more thoroughly. Especially concerning entrepreneurship, we want to capture not only realized projects, but also private fringe initiatives (e.g. short-term rental activities such as Airbnb). In terms of subject response, we note the promising possibility to influence personal habits through the very act of surveying or engaging people with the app (the Hawthorne effect). Once households actively participate in the study, we can use the platform to do random assignments and controlled treatments. This can be an additional benefit of the project, beyond the actually retrieved data. In this section, we propose three examples of potential research corresponding to the three survey modules.

ENTREPRENEURSHIP AND PRODUCTIVITY

The first concerns investigating the impact of social capital on entrepreneurship. According to Davidsson and Honig (2003, p. 307), 'social capital refers to the ability of actors to extract benefits from their social structures, networks and relationships'. Social capital can exist in different levels. For example, at the community level, social capital may be proxied by the quality of social networks within the locality (Parker, 2009). Social capital is important to the

formation and viability of entrepreneurship since it facilitates information exchange about the potential opportunities, suppliers, customers and competitors. However, there is very limited empirical evidence studying the causal effect of social capital on entrepreneurship due to several difficulties. First, it is not easy to find a high quality empirical proxy for social capital, reflecting limited data and a lack of agreement about how to measure this construct. Second, social capital is likely to be correlated with other unobservable characteristics, such as ability, human capital and financial capital, making it challenging to isolate the effect of social capital from other confounding factors (Parker, 2009).

We propose to identify the causal impact of social capital on entrepreneurship by randomizing the formation of social capital. To be more specific, we elicit people's entrepreneurship experience in the baseline survey (e.g., "Are you currently self-employed?" If the person has such experience, we further query the industry type that the individual is engaged in, using questions such as "What industry are you working in?" and "What are the estimated sales of your firm/entity?"). In addition, we also ask them about their interests in engaging in entrepreneurship activities and then randomly form entrepreneurship interest groups within a community for regular meetings, such that those that are interested in entrepreneurship can interact with other successful (or not so successful) entrepreneurs. We track their interactions using the app, since the respondents directly record daily activities.

By comparing the entrepreneurship activities of people with and without participating in such interest groups, and before and after joining the group, we are able to paint a picture on how social capital affect the formation and success of entrepreneurship activities. Moreover, we can generate variations on group size and the similarity of industry experiences/educational backgrounds, which help us to learn more about the specific mechanisms that social capital affect entrepreneurship.

SOCIAL CAPITAL AND INCLUSION

Another example concerns estimating the effect of the urban environment on social inclusion. According to the World Bank definition, social inclusion is 'the process of improving the terms for individuals and groups to take part in society' (World Bank, 2013). To be more specific, it refers to 'the process of improving the ability, opportunity, and dignity of people, disadvantaged on the basis of their identity, to take part in society' (World Bank, 2013). The urban approach provides an innovative perspective in this context, as cities are the places where individuals face new opportunities and accumulate new skills (Lucas, 2004). Urban externalities, through social interaction with neighbours/friends or within social groups, stimulate human capital upgrading and improve social integration and mobility.

We quantify the notion of social capital, by accumulating which to achieve social inclusion, through three perspectives. First, within families, we use mobile app to track household behaviours (such as gift exchange or inheritance) among family members, as families are the fundamental elements of society and where the social capital is accumulated (Blanchflower and Oswald, 1998). Second, for neighbourhood contacts and friendships, the app-based survey helps to record the frequency of visiting neighbours/friends and the location of interaction to capture the obtaining of social opportunity from this channel. Third, for group involvement, we propose to ask questions such as "Are you a member of any sports club/choir/church, etc.?" and "How many times per year do you visit the club?" to quantify the social interaction within specific groups.

Theoretically, previous research in urban studies examines the density externality taking social interaction into the utility function, though in a uniform form (Brueckner and Largey, 2008). However, social inclusion is heterogeneous depending on the local contexts (such as neighbourhood demographics and affordability). Furthermore, there is a trade-off between diversity and inequality, which are both outcome of a high level of social inclusion. Using the app-based data which collect comprehensive information on household characteristics and behaviour, we are able to compute an optimal level of social inclusion in theory (such as an optimal age structure in a neighbourhood), compare with the level of social inclusion in reality, and design the converging path. .

Moreover, the urban policy analysis can also be incorporated in this data framework to estimate specific policy impacts on social inclusion. By comparing the social inclusion pattern before and after an urban policy (such as neighbourhood renewal), and between treated and control groups, we are able to identify the causal effects of urban policy. Instrumental variable estimation can also be applied to examine the policy effects of quasi-natural policy experiment (Brueckner and Largey, 2008). In addition to the passive policy evaluation, we can use the platform to do random control trials (such as void deck upgrading), to test the hypothesis in urban theories and provide policy implication for the government agencies.

HOUSEHOLD FINANCE AND RESILIENCE

Experiences, preferences and constraints differ widely among individuals and these factors can have long-lasting effects on financial choices. In principle, an urban context should serve as an equalizer and allow for quick access to information with low administrative costs. This translates into dynamic labour markets, and higher resilience in the face of adverse shocks. One important determinant of non-market financial interactions is the issue of trust – a cultural attribute with deep historical roots. Guiso et al. (2008) show that trust impacts households' engagement in formal financial transactions and that a lack of it can dramatically alter investment patterns, decreasing social inclusiveness. A “good” neighbourhood should decrease intellectual and cultural barriers and stimulate positive interactions that increase mutual trust and facilitate the constructive flow of ideas.

Recent international evidence also point to the importance of culture. Households are slow to adjust to the investment norms of their new home country (Haliassos et al. 2016) and despite moving across borders, they retain the investment habits of their country of origin. Historical experiences can themselves have long-lasting negative effects, for example, in terms of risky asset investment (see Malmendier and Nagel 2011, who analyze household data from the US), mortgage product choice (see Malmendier and Nagel 2016 for the US and Ehrmann and Ziegelmeyer 2016 for Euro area countries) and residential home-ownership (see Badarinza et al. 2016b for India). In Singapore, there is little formal evidence akin to these observations, especially in an urban context - a surprising research gap, given the very diverse ethnic background of the country's citizens and the intense financialization of the local economy.

Also, from a theoretical perspective, the link between the urban environment, the financial decisions of households, their cultural predispositions, deep preferences and ultimate resilience in face of shocks remains largely unexplored, not only in Singapore but also abroad. If we can achieve significant progress in terms of understanding neighbourhood externalities and the role of the built environment, the results will likely attract both the interest of the international academic audience and be informative for the immediate domestic policy context.

So far, the availability of data does not allow for a holistic view of the households' balance sheet. Similarly to the way we think about the business soundness of companies, what determines people's vulnerability is the simultaneous dynamics of debt (as a source of exposure to negative shocks) and liquid wealth (as a short-term coping mechanism). Since previous data collection efforts either focus on just one particular aspect of financial behaviour or miss the spatial dimension entirely, ignoring neighbourhood externalities, our approach is expected to generate insights both into fundamental economic principles and measureable policy outcomes. Concretely, we plan to explore the transmission mechanisms and effects of the following types of policies:

- 1) Mortgage lending restrictions: Changes in maximum LTV ratios or in cash downpayment requirements have been shown to have ambiguous consequences or elicit delayed responses by households, who are inert, inattentive and sometimes behave sub-optimally when choosing mortgage or investment products, failing to gauge the long-term nature of policy decisions (see Andersen et al. 2015 and Badarinza et al. 2016a).

- 2) Buyer's and seller's stamp duty: Changes in the taxation regime are part of the government cooling measures and have a direct impact on the constraints of households

envisioning home-ownership real estate investment. They define the playing field both in the secondary private market and for development companies, with material consequences on the domestic economic environment (see Phang et al. 2014).

3) CPF regulation and reform: The government is constantly effecting change to CPF policy, with the goal of improving flexibility, financial resilience and sustainability in old age. A recent example evaluates the effects of 2008 Extra Interest policy on the saving behavior of CPF members (see Agarwal, Deng and Zhu 2016). Another example concerns the option to cash out a fraction of pension savings at age 55 (see Agarwal, Pan and Qian 2015).

4) Evaluate impact of government monetary policy and corporate/individual investors response and behaviour. (See Deng et al. 2015, and Wu et al. 2015 for recent studies on Asia housing markets, such as China).

5) Evaluate effectiveness of environmental sustainability, energy resilience and economic return on green building policy, as well as household/company's behaviour in response to such policies (See Deng et al 2012(a), Wu et al 2014, Deng and Wu 2014(b)).

6) The major challenges in evaluating competing claims of market conditions and policy impact in Asia and other booming markets come from the data limitations and lack of reliable measurement metrics (see Wu et al 2016). The survey data will allow us to develop new and scientific based indices to measure the market conditions (see Deng et al 2012(b), and Deng et al 2014(a)).

7) Fair lending practices and consumer protection: The main challenge of the financial system of this day and age is to make product innovation work better for consumers who lack understanding of the opportunities and risks they face (see Campbell 2016 and Badarinza et al. 2016b for a comprehensive review).

Compared with previous research, our approach is distinguished by the following features:

1) Integrated tracking of financial outcomes, the urban environment and individual preferences and behaviour.

2) The unique possibility to exploit unexpected policy changes and life events to achieve empirical identification and document the diversity of experiences across the city.

3) The focus on neighbourhood externalities as the particular mechanism for the spatial diffusion of shocks.

4) The multiple interactions between entrepreneurship, financial innovation, social capital and the design of urban spaces.

F. CONCLUSION

The precise empirical evaluation of public policy outcomes is notoriously elusive, both for academic researchers and policy making institutions such as national and local governments, central banks and financial regulatory authorities. The challenge is even more pronounced in a rapidly changing world with rising informal entrepreneurship (e.g. Uber and Airbnb), rapid fragmentation of the public discourse (e.g. through fringe media initiatives and blogs) and rapid diffusion of global uncertainty shocks (e.g. through correlated exposure of asset portfolios). To overcome these barriers, we propose a data collection agenda and a research framework based on a holistic view of household living conditions and urban externalities, applied to the particular case of Singapore and South-East Asia. The core of our data collection approach is a mobile app, eliciting real-time response of households and allowing for the integrated tracking of behaviour, preferences and constraints. This allows for more transparent and systematic inquiries into the multi-dimensional links between urban interactions, knowledge spillovers, entrepreneurship and the sustainable development of diverse communities, with a particular focus on urban policy interventions and their long-term effects.

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