Sustainable Development in French Cities

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Introduction

Luís Bettencourt proved empirically that the dynamics of urbanization, economic development and knowledge creation can be generally related across cities regardless of nation or time period. His study also showed that American and German cities have varying but predictable scaling relations that inform a city's long-term sustainability. Yet, certain sociologists believe that French cities are fundamentally different than other cities.

They note that French cities are much older than their U.S. counterparts. These cities are influenced by the past as they must contend with a long history (Cattan, et al), something that younger U.S. cities presumably don't contend with. Additionally, French cities are unique because of their sociopolitical structure.

Unlike in America and in other European countries, the political and economic primacy of their urban centers have never been challenged (Cusin). Many French cities have a very dynamic center core while suburbs are less dynamic, as evidenced by average home and land values.

Therefore, our goal is to examine these two seemingly contradictory views on urban France. We'll evaluate whether French cities are in fact unique in their scaling relations and sustainability or whether they follow Bettencourt's city scaling model.

Data Dive & Evidence

This undertaking will require a fair bit of mathematical processing and database management to sew pieces of data from many large foreign datasets into a coherent tapestry. Ideally, this process mimics Bettencourt's work as closely as possible. I've attempted to make a rough outline of this process below.

To reach our goal, data will be sourced from the *Institut national de la statistique et des études économiques* (Insee), the French national statistics bureau and France's Ministry of the Economy. All of our data is from 2015, when the last nationwide census was conducted in France.

A. Defining a City

The first step will be to define the geographic boundaries of a city. Luckily, Insee provides a dataset of each metropolitan area in France, that are defined similarly to U.S. Census and Office of Management and Budget Metropolitan Statistical Areas (MSAs) used by Bettencourt in his analysis.

The French urban areas, or *aires urbaines*, are defined as a continuous ensemble of communes that contain an urban center of at least 10,000 jobs and where at least 40% of employed residents commute to said urban center (Insee).

This methodology suits our purposes because it defines a city not by artificial political borders that could introduce bias into our results (Bettencourt, et al), but by societal and economic characteristics.

B. Studying Urban Indicators

The second step will be to populate each metropolitan area with a standard set of city attributes. The following urban indicators are going to be studied. These indicators were chosen because of their similarity to Bettencourt's indicators and categories (Bettencourt, et al).

Construct	*Economies of Scale in Infrastructure*	*Fulfillment of Human Needs*	*Rate of Innovation*	*Skilled and Educated Workforce*
Urban Indicator Proxy	Number of Gas Stations	Total Employment	New Businesses	Number of Skilled Workers (i.e. Engineers, Professors, Doctors, Lawyers, etc…)

Each indicator will be sourced from Insee datasets or France's national open data portal. All of this data is provided per commune. Thus, we will have to aggregate up to the metropolitan area level as a part of our processing.

C. Data Processing and Final Result

Our five indicators are then going to go through a data processing workflow. This workflow will take the values of an urban indicator across all metropolitan areas in France as inputs. The output will be a scaling exponent (β) from the following power law equation (Bettencourt, et al)

Power Law Model Equation

For,

- $N(t)$ be the population of a city at time *t,*
- Y_0 a normalization constant
- $Y(t)$ be the value of an urban indicator at time t

The Power Law Equation is,

$$Y(t) = Y_0 N(t)^{\beta}$$

The scaling exponent (β) will be used as a statistical proxy for the dynamic construct we are studying, and ultimately it would help model the dynamic forces of sustainable development in French cities. If French cities scale similarly to their American and German counterparts, we would expect our urban indicators' scaling exponent (β) to be similar to American and German ones found by Bettencourt.

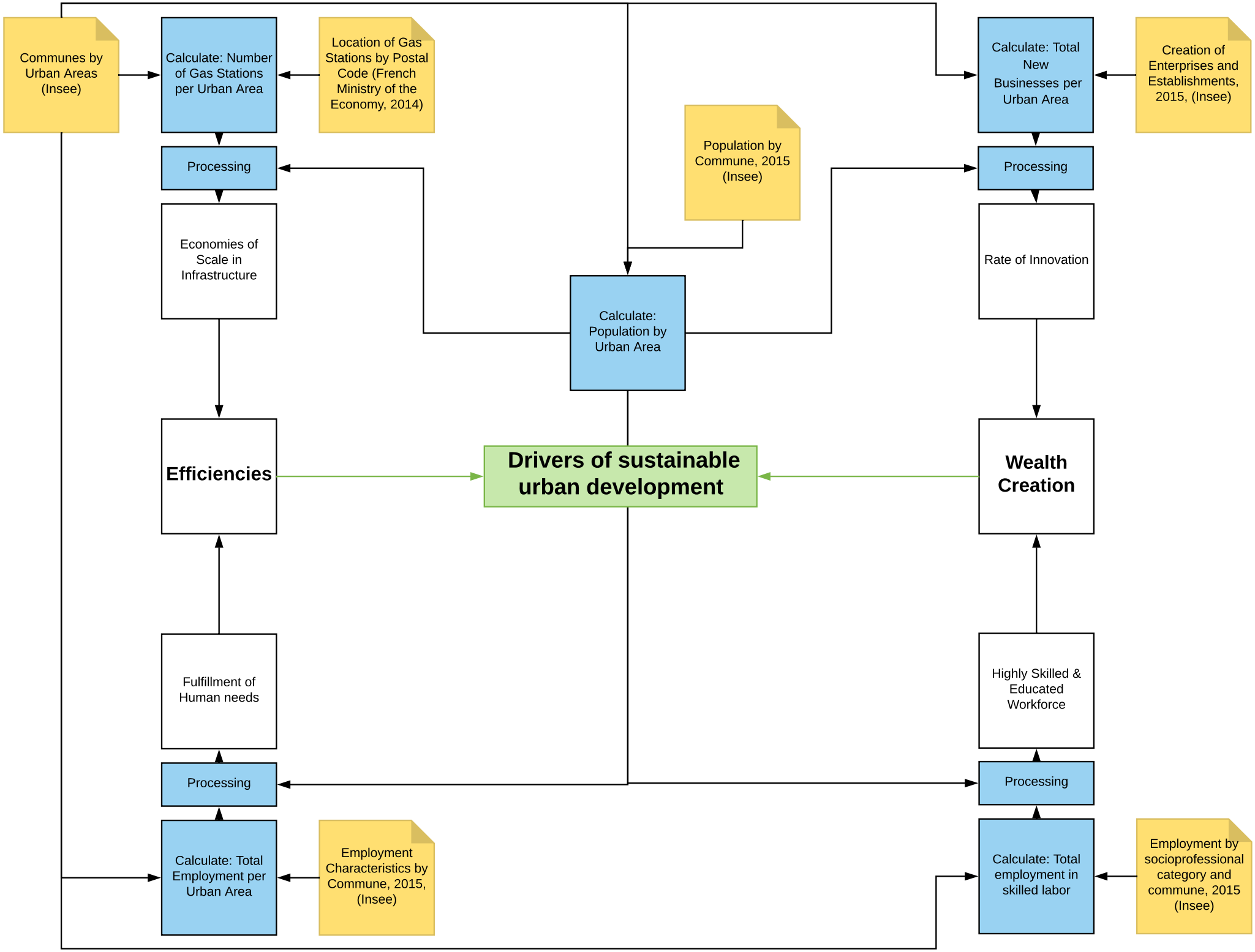
Bibliography

Bettencourt , Luís M. A. , et al. "Growth, innocation, sclaing and the pace of life in cities." *PNAS* 104.17 (2007): 7301-7306.

Cattan, N, D Pumain and C Rozenblat. *Le système des villes européennes*. Paris, 1999.

Cusin, François. "Y a-t-il un modèle de la ville française ?" *Revue française de sociologie* 57 (2016): 97-129.

Institut national de la statistique et des études économiques (Insee). *Base des aires urbaines*. 27 September 2018. 3 February 2019.


Communes by Urban Areas (Insee)
Calculate: Number of Gas Stations per Urban Area
Location of Gas Stations by Postal Code (French Ministry of the Economy, 2014)
Calculate: Total New Businesses per Urban Area
Creation of Enterprises and Establishments, 2015, (Insee)
Population by Commune, 2015 (Insee)
Processing
Processing
Economies of Scale in Infrastructure
Rate of Innovation
Calculate: Population by Urban Area
Efficiencies
Drivers of sustainable urban development
Wealth Creation
Fulfillment of Human needs
Highly Skilled & Educated Workforce
Processing
Processing
Calculate: Total Employment per Urban Area
Employment Characteristics by Commune, 2015, (Insee)
Calculate: Total employment in skilled labor
Employment by socioprofessional category and commune, 2015 (Insee)