

Financing Public Transport Infrastructures by Means of Value Capture Provided by Its Implementation

Hostilio Xavier Ratton Neto, Romulo Dante Orrico Filho and Herlander Costa Alegre da Gama Afonso
Transportation Engineering Program, Federal University of Rio de Janeiro, Rio de Janeiro 21941-914, Brazil

Abstract: A transport infrastructure is not only a trip provision system but a public facility that generates value for companies and for the society through expanding markets or developing cities, creating another perspective for new investments, as well as its own financing. According to this perspective, the financial earnings resulting from the implementation of transport infrastructure can be captured for its own investment. Given the restrictions of society indebtedness, due to social inequalities, scarcity of resources and insufficient fare collection, with the current financial model for public transport infrastructures, the value capture configures as a strategy to be explored to obtain resources. This paper presents the concept of value capture and its connection and relevance with transport infrastructure financing strategies. Applied to the evaluation of the impacts on the surrounding regions of one of the most significant Brazilian transport projects, the improvement and expansion of Belo Horizonte's metro, the provided value capture outcomes open more realistic perspectives for greater engagement of the Public Sector in such projects.

Key words: Value capture, infrastructure financing, public transportation, urban development.

1. Introduction

According to Barat [1], the historical process that gave form and content to the current urban structure of the biggest Brazilian metropolitan areas, urban evolution and rail transport provision are intimately linked: the railroad's lineal form of territorial structuring has driven the socioeconomic development of the surrounded areas and the neighborhoods. Besides, Aragao [2] detaches the well discussed and documented importance of technical infrastructures for economical growth and e-development [3-8]. In Brazil, several authors [9-13] have accomplished approaching studies about the positive relationships between infra-structural investment, productivity and economical growth. In such context, investments in metro-rail infrastructure appear to be of paramount importance to society, either as part of induction to socio-economic development as a tool for social inclusion and urban structuring, providing other economical and social benefits, such as accessibility

and mobility improvement, and pollutant emissions and travel time reduction.

However, one of the biggest financial gains, resulting from public investment, the increase of real estate value, goes to the land owners, without any return to society, fomenting speculation, with adverse effects on urban development, such as reservation of vacant land and even greater segregation of the city space. Due to that, if it was possible to implement a mechanism for the financial recovery of at least a part of the expended public capital from the obtained private benefits, such distortion could be corrected by generating resources to other investments on behalf of the common well-being. Such mechanism actually exists, it is called value capture, as defined by the OECD—Organization for Economic Co-operation and Development [7] in Pedler [14], whereby the responsible agent for the infrastructure development transfers part of the land proprietors' financial gains to society.

Aragão [2] also states that the abundant literature about transit oriented development and value capture provides sufficient evidence not only for the fiscal

Corresponding author: Herlander Costa Alegre da Gama Afonso, M.Sc., research field: public transport. E-mail: herc_afonso@hotmail.com.

viability of this approach, but also for its limitations and constraints [15-20]. In Brazil, this procedure is already legally possible by several instruments under the Statute of the City [21, 22].

According to Lima Neto [21], this definition of VC (value capture) is an adaptation of the widely internationally discussed capture value concept, which allows the collection of the induced private owned land's profits by the public administration, in its role of the development ruler, to finance urban projects. The fundamental basis of the capture is the concept of surplus value, which is the value or benefit incorporated by urban real estate due to urbanization or normative instruments that delegate an increment on the constructive potential of the land.

Investments in infrastructure are mainly made by the government. Value capture shows how much the increase of the taxes revenues, exclusively due to the project's economical benefits, would cover, in a cash flow, the government's financial commitments. It is therefore a new approach of the financial viability analysis of infrastructure projects, directly related to its true reason of being, that is to promote the economical growth of the served area.

This paper is an exercise to present an evaluation of the recoverable share of the metro-rail infrastructure public financing. Value capture from real estate and income taxes of beneficiary activities of changes on the pattern of land use could finance at least a part of the their own infrastructure investment costs and other public projects. The evaluation was applied to the improvement and expansion plan for the Line 1 of the Belo Horizonte's metro-rail network, in Brazil, considering: (1) the potential collection from profits due to real estate higher market prices; (2) the additional collection of the IPTU (Urban Property Tax) corresponding to the built surface enhancement; (3) the additional collection of the ICMS (Added Value on Goods and Services Tax) and of the ISS (Services Tax) corresponding to the construction activities in the enhanced built surface; (4) the ISSQN (additional

collection of the Services of Any Nature Tax) on behalf of service activities generated in the enhanced built surfaces.

2. A Brief Historical Report of the Belo Horizonte's Metro-Rail Transportation System

In the late 1970s, the Brazilian Ministry of Transport has decided to develop a project that simultaneously could solve the bottlenecks problem in freight rail lines and provide better urban passenger transport offer in the Belo Horizonte's metropolitan area. In this sense, the project of the metropolitan train of Belo Horizonte was developed. The existing rail track was duplicated and two new tracks were built to a surface metro, aiming to reduce construction costs and solving the problem of the metropolitan area crossing by freight trains.

The first design plans provided a line between the city of Betim, in the east of the metropolitan area, and the São Gabriel district, with a branch to the Barreiro district, totaling 60 km of dedicated railway tracks (no interference with vehicular traffic and pedestrians), 22 stations, 25 electric trains, workshops, yards, intermodal integration terminals, support facilities, and energy, supervision, control and telecommunications systems. Works began in 1981, scheduled to be achieved in 1986, on a 37 km long priority section, consisting of the 26.5 km long Eldorado-São Gabriel and the 10.5 km long Calafate-Barreiro branches.

However, the available resources were reduced and the schedules were subsequently extended until 1987, when works have practically stopped. Under such conditions, the metro operation comprised only the 12.5 km long Eldorado-Central section, with seven stations and a fleet of only five trains.

Construction works have resumed in 1991, but with significant changes compared to the original goals:

(1) The Eldorado-Betim branch has been postponed;

(2) The Barreiro district branch was no longer a priority;

(3) The priority line became the North vector toward the Venda Nova district;

(4) Inclusion of three more stations in the Eldorado-São Gabriel branch: Vila Oeste (and New Bus Station), José Cândido da Silveira and Mines Shopping.

Since 1995, the deployment of Line 1 has gained new force, after the signing of a financing contract with the World Bank. With this funding, the Eldorado-Vilarinho section began to operate in all its extension. At the same time, the Federal Administration has started the Belo Horizonte's metro undertaking transfer process from the CBTU-Brazilian Urban Trains Company, a Federal Government owned company, until then responsible for its construction and operation, to local authorities.

This process, known as the "metro's regionalization", still ongoing in 2010, will be achieved after the assignment of the state of Minas Gerais and the Belo Horizonte and Contagem municipalities as new responsibilities.

3. General Characteristics of the Belo Horizonte's Metro Line 1 and of Its Influenced Area

The Belo Horizonte's metro Line 1 has 28.2 kilometers of double track, covering the Belo Horizonte and Betim municipalities. It connects the Northern and Western urban growth vectors—the biggest—of the metropolitan area, but it does not cross the Belo Horizonte's downtown center, it just borders it. It has 19 operating stations, four of them intermodal integration terminals: Eldorado, José Cândido, São Gabriel and Vilarinho. Another intermodal terminal will be built coupled with the future Nova Rodoviária (New Bus Station).

The ongoing negotiations of the metro's regionalization, between the Federal Government, the Government of the state of Minas Gerais and the Belo

Horizonte and Contagem municipalities involve the necessary investments to substantially improve the operating conditions of Line 1, increasing its capacity and ensuring its better economic performance.

The available data and information were collected from many sources for this evaluation exercise. The geographic and socioeconomic information about the metro's surrounding area were obtained from the IBGE's (the Brazilian Institute of Geography and Statistics) of and the João Pinheiro Foundation (the Minas Gerais state's data and information basis) websites. The metro's sections lengths were taken from the Google Earth maps software. In addition, the forecast of the examined scenarios has required some inferences, adopted by means of consensus among the authors.

For this exercise's purposes, the line was divided in four sections: Novo Eldorado-Nova Rodoviária (5,547 m long), Nova Rodoviária-Central (5,519 m long), Central-São Gabriel (9,316 m long) and São Gabriel-Vilarinho (7,819 m long). The surrounding influenced area was assumed to be 1,600 m wide alongside the line.

According to Table 1, in 2007, Belo Horizonte had a total of 2,412,937 inhabitants, while Betim counted 415,098. In the same year, the population of the considered influenced area, corresponding to 13.6% of the total surface of the city, was 281,997 people (11.7% of the entire city's population).

Based on these data, the following determinations were made for each section of Line 1:

(1) Project's influenced area;

(2) Population density in inhab./km, estimated according to the densities of the regions through which the line passes, both in Belo Horizonte and in Betim;

(3) Population of the influenced area, the multiplication of such area by its population density.

Table 2 summarizes such determinations.

The population in the influenced area was calculated and the evolution of the Line 1 demand

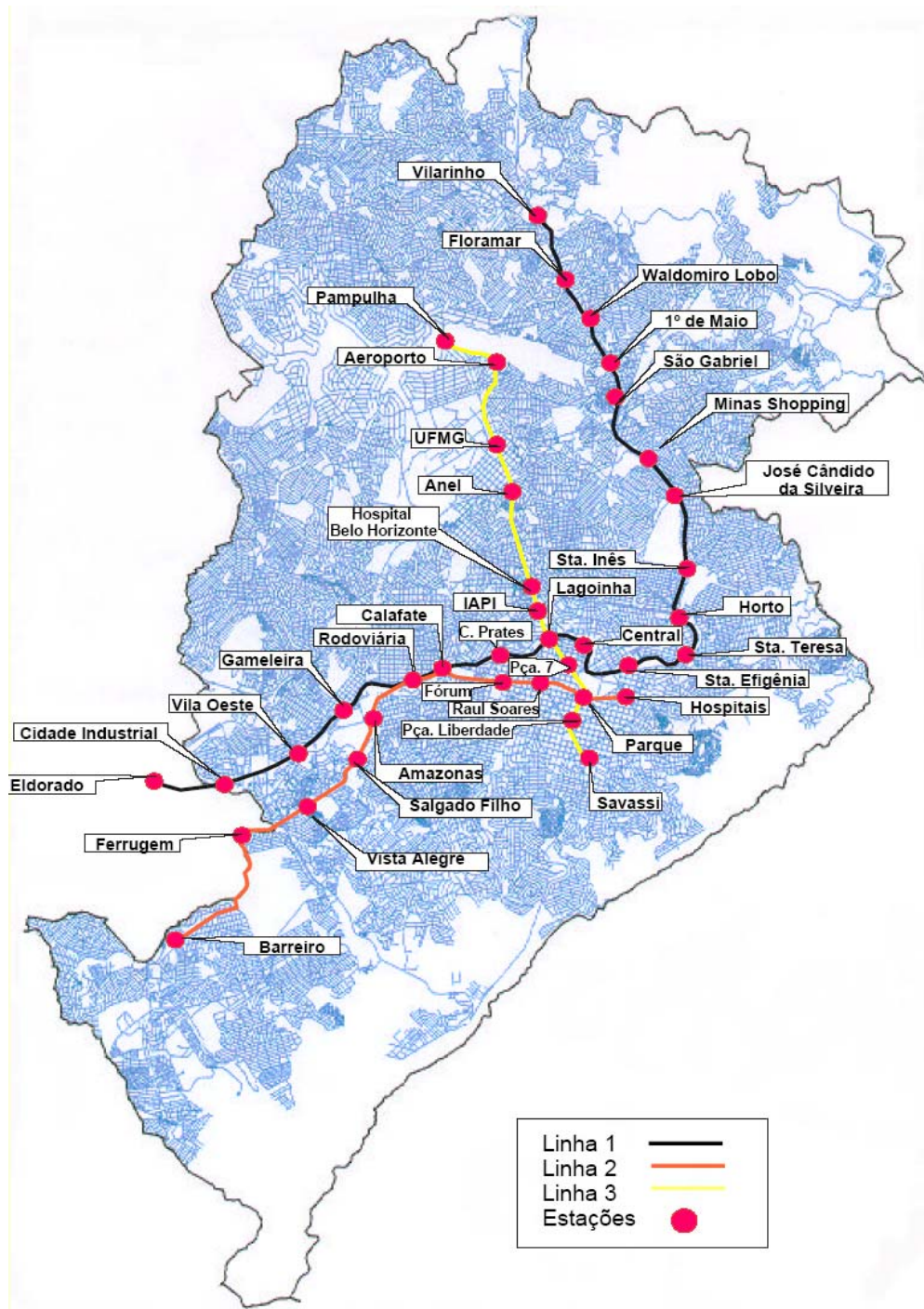


Fig. 1 Belo Horizonte’s metro lines.

Table 1 Population, surface and population density in Belo Horizonte, Betim and in the influenced area by the Belo Horizonte’s Metro Line 1.

	Belo Horizonte	Betim	Line 1	Line 1/BH
Population in 2007 (inhab.)	2,412,937	415,098	281,997	11.7%
Area (km ²)	331.0	346.0	45.1	13.6%
Density (inhab./ha)	72.9	12.0		

Source: IBGE [24].

growth rates was estimated for 2017 (Table 3) from the available population data [23]. Therefore, basis on the Belo Horizonte and Betim population numbers in 2007 and adopting, respectively, annual growth rates of 1.16% and 4.54%, with a spatial population distribution of 75% and 25%, the sum-product value was calculated equal to 2.00%. It was the adopted growth rate to determine the additional population inside the influenced area in 2017, which are 61,471 inhabitants.

The occupation of the influenced areas was calculated as follows: 51% (45.1 km²) of its total surface were deducted, assumed as for the streets, wide open spaces and green areas; The remaining land, available for real estate, was classified as occupied areas (to improve and maintain), special areas and green areas; In addition, this occupation was decomposed by use in housing and commercial/services, according to the population’s income patterns A, B, C and D, and leisure areas.

4. Potential Collection of the Tax on Real Estate Assets Due to the Improvements on Line 1

The Tax on Real Estate Assets depends on the built occupied lands and their asset values. Two possible contexts were compared: with and without investments for the expansion and improvement of the line. For the purposes of this evaluation exercise, taking account of the difficulty to obtain and treat the actual and complete data in order to classify land use occupation by kind of occupation and kind of

economic activities of the buildings in the area of influence of Line 1, some “reasonable” arbitrary values were assumed for the calculations:

- The percentage of land occupation in each property;
- The average number of floors of the buildings;
- The market values per m² of real estate assets.

The former occupied and built surfaces were then determined as displayed in Tables 4-6. Those are the initial land occupation conditions of the “without investments” context.

For the “with investments” context, it was assumed that the same distribution of occupation patterns would have been kept, but there would be a built surface enhancement, calculated as the deduction of the total built surface of the “without investments” context from the total built surface of the “with investments” context, because of changes on the number of floors of the buildings. Tables 7-9 summarize these determinations.

The real estate’s higher prices of the enhanced built surface were obtained from the multiplication of that surface by its asset value by the end of the analysis period. The recoverable amount of the Tax on Real Estate’s Assets was deduced from such land price augmentation. Tables 10-13 present how were made the calculations.

5. IPTU (Additional Urban Property Tax) Collection

The additional urban property tax collection would depend on the enhanced built surfaces due to the expansion and improvement of Line 1 (differences

Table 2 Population and population density in the influenced area.

Section	Start	End	Lenght (m)	Surface (m ²)	Population	Density (inhab./ha)	Remarks
1	Novo Eldorado	Nova Rodoviária	5,547	8,874,800	23,247	26.2	Half Betim + BH West
2	Nova Rodoviária	Central	5,519	8,830,000	43,933	49.8	Half BH West and BH Northwest
3	Central	São Gabriel	9,316	14,905,200	134,484	90.2	BH Average (Center South + Northeast + East)
4	São Gabriel	Vilarinho	7,819	12,510,000	80,332	64.2	Average of (Northeast + East)
Totals and averages			28,200	45,120,000	281,997	62.5	

Table 3 Forecast of the population growth inside the influenced area in 2017.

Place	Population (2007)	Annual growth rate	Populations distribution	Population (2017)	Increment
Belo Horizonte	2,412,937	1.16%	75%	2,707,701	294,764
Betim	415,098	4.54%	25%	647,176	232,078
Line 1	281,997	2.00%	-	343,468	61,471

Table 4 Percentage of land occupation patterns in the properties inside the influenced area by the Belo Horizonte's Metro Line1, in the "without investments" context.

Land use	Occupied areas		Special areas	Green areas
	To enhance	To maintain		
Housing	65%	65%	10%	60%
Pattern A	13.0%	13.0%	2.0%	12.0%
Pattern B	26.0%	26.0%	4.0%	24.0%
Pattern C	19.5%	19.5%	3.0%	18.0%
Pattern D	6.5%	6.5%	1.0%	6.0%
Commercial/Services	25%	25%	3%	3%
Pattern A	5.0%	5.0%	0.6%	0.6%
Pattern B	10.0%	10.0%	1.2%	1.2%
Pattern C	7.5%	7.5%	0.9%	0.9%
Pattern D	2.5%	2.5%	0.3%	0.3%
Leisure	10%	10%	87%	37%
Total	100%	100%	100%	37%

Table 5 Average number of floors of the buildings inside the influenced area in the "without investments" context.

Land use	Occupied areas		Special areas	Green areas
	To enhance	To maintain		
Housing				
Pattern A	1.50	1.20	0.01	0.01
Pattern B	1.30	1.50	0.01	0.01
Pattern C	1.20	1.40	0.01	0.01
Pattern D	0.95	0.85	0.01	0.01
Commercial/Services				
Pattern A	1.15	1.30	0.01	0.01
Pattern B	1.15	1.30	0.01	0.01
Pattern C	1.15	1.30	0.01	0.01
Pattern D	1.15	1.30	0.01	0.01
Leisure	1.00	1.00	0.01	0.01

Table 6 Built surface of the properties inside the influenced area, in the "without investments" context, in m².

Land use	Occupied areas		Special areas	Green areas
	To enhance	To maintain		
Housing	2,692,310	9,230,401	1,624	4,873
Pattern A	633,485	1,647,060	325	975
Pattern B	1,098,040	4,117,651	650	1,949
Pattern C	760,182	2,882,356	487	1,462
Pattern D	200,604	583,334	162	487
Commercial/Services	933,984	3,431,376	487	244
Pattern A	186,797	686,275	97	49
Pattern B	373,594	1,372,550	195	97
Pattern C	280,195	1,029,413	146	73
Pattern D	93,398	343,138	49	24
Leisure	324,864	1,055,808	14,132	3,005
Total	3,951,158	13,717,585	16,243	8,122

Values obtained by the multiplication of the total surface of the properties by the Table 4 percentages and by the numbers of floors taken from Table 5, deduced of 25%, due to legal limitations of the built surface due to the number of floors, according to the authors' estimations.

Table 7 Average number of floors of the buildings inside the influenced area, in the “with investments” context.

Land use	Occupied areas		Special areas	Green areas
	To enhance	To maintain		
Housing				
Pattern A	3.00	1.22	0.01	0.01
Pattern B	2.60	1.53	0.01	0.01
Pattern C	2.22	1.43	0.01	0.01
Pattern D	1.76	0.87	0.01	0.01
Commercial/Services				
Pattern A	2.30	1.33	0.01	0.01
Pattern B	2.30	1.33	0.01	0.01
Pattern C	2.13	1.33	0.01	0.01
Pattern D	2.13	1.33	0.01	0.01
Leisure	1.50	1.02	1.00	1.00

Values proposed by the authors.

between built surfaces of the “with” and “without investments”, as shown in Table 9). For this exercise’s purposes, the usual charged rates (0.80% of the market price for housing and 1.60% for the commercial and service ones, respectively), were reduced to 0.29% and 0.76% in order to simulate the effect of some aspects such as the underestimation of the market value of the property, the under-reporting of this value and the reduction due to the time of use (the building’s age). The results of this calculation are shown in Table 14.

Additionally, the authors proposed that the allocated share to cover the investment costs would be limited to 30% from the total property tax collection due to the expansion and improvement of Line 1, reaching R\$ 6,533,560.57.

6. ICMS (Additional Collection of the Added Value on Goods and Services Tax) and ISS (of the Services Tax) Due to the Construction Activities in the Properties

The ICMS (additional added value on goods and services tax) income due to the construction works to the enhanced built surfaces inside the influenced area of the Belo Horizonte’s Metro Line 1 was assumed to be charged on the construction materials acquisition costs, while the ISS (services tax) would be related to

the whole construction costs. The materials cost estimate was assumed to be equal to 40% of the construction costs. The construction costs were assumed to be the remainder of the deduction of the real estate profits and the cleared land costs from the real estate profits due to the increased built surfaces (Table 11 values). The cleared land cost was assumed to be equal to 15% of total construction costs (labor + cleared land acquisition costs).

It was also assumed that 60% of the construction materials would be purchased in the state of Minas Gerais, where the average ICMS rate is 16%. The remaining 40% would come from other states, whose rates were assumed to be around 8%. It was still assumed that the ICMS collection share between the state’s Government and the municipalities is 75% and 25%, respectively, and Belo Horizonte and Betim are provided with 12.4% and 2.0% of the municipalities’ share, the corresponding percentages for their respective populations and the state’s population.

The same underestimations of property market values and of their under-reporting assumptions (displayed on Table 11) were applied to the ICMS and ISS collection estimations.

Finally, it was also assumed that the recoverable part of the investments on Line 1 would be 40% of the total collected taxes inside its influenced area.

Table 8 Built surface of the properties inside the influenced area, in the “with investments” context, in m².

Land use	Occupied areas		Special areas	Green areas
	To enhance	To maintain		
Housing	5,240,503	9,415,009	1,626	4,878
Pattern A	1,266,970	1,680,002	325	976
Pattern B	2,196,081	4,200,004	650	1,951
Pattern C	1,406,336	2,940,003	488	1,463
Pattern D	371,117	595,001	163	488
Commercial/Services	1,811,929	3,500,004	488	244
Pattern A	373,594	700,001	98	49
Pattern B	747,187	1,400,001	195	98
Pattern C	518,361	1,050,001	146	73
Pattern D	172,787	350,000	49	24
Leisure	487,296	1,076,924	14,132	3,005
Total	7,539,728	13,991,937	16,245	8,127

Values obtained by the multiplication of the total surface of the properties by the Table 4 percentages and by the numbers of floors taken from Table 7, deduced of 25%, due to legal limitations of the built surface because of the number of floors, according to the authors' estimate.

Table 9 Enhanced built surface of the properties inside the influenced area, in the “with investments” context, in m².

Land use	Occupied areas		Special areas	Green areas
	To enhance	To maintain		
Housing	2,548,193	184,608	2	5
Pattern A	633,485	32,941	0	1
Pattern B	1,098,040	82,353	1	2
Pattern C	646,154	57,647	0	1
Pattern D	170,513	11,667	0	0
Commercial/Services	877,945	68,628	0	0
Pattern A	186,797	13,726	0	0
Pattern B	373,594	27,451	0	0
Pattern C	238,166	20,588	0	0
Pattern D	79,389	6,863	0	0
Leisure	162,432	21,116	-	-
Total	3,588,570	274,352	2	5

Values obtained by deduction of the Table 6 values from those of Table 8.

Table 10 Average real state's market prices inside the influenced area, in the “with investments” context.

Land use	Average prices (R\$/m ²)			
	To enhance	Occupied area To maintain	Special areas	Green areas
Housing				
Pattern A	1,440	1,440	1,440	1,440
Pattern B	960	960	960	960
Pattern C	600	600	600	600
Pattern D	240	240	240	240
Commercial/Services				
Pattern A	3,000	3,000	3,000	3,000
Pattern B	1,800	1,800	1,800	1,800
Pattern C	1,200	1,200	1,200	1,200
Pattern D	600	600	600	600
Leisure	1,200	1,200	1,200	1,200

Values proposed by the authors.

Table 11 Market prices of the enhanced built surface of the properties inside the influenced area, in the “with investments” context.

Land use	Land assets market prices (R\$ 1,000)				
	Occupied areas		Special areas	Green areas	Total
	To enhance	To maintain			
Housing	2,394,953	163,883	1	4	2,558,841
Pattern A	912,218	47,435	0	1	959,655
Pattern B	1,054,119	79,059	1	2	1,133,180
Pattern C	387,693	34,588	0	1	422,282
Pattern D	40,923	2,800	0	0	43,723
Commercial/Services	1,566,291	119,412	1	0	1,685,704
Pattern THE	560,390	41,177	0	0	601,567
Pattern B	672,468	49,412	0	0	721,881
Pattern C	285,799	24,706	0	0	310,505
Pattern D	47,633	4,118	0	0	51,751
Leisure	194,918	25,339	-	-	220,258
Total	4,156,162	308,634	2	5	4,464,803

Values calculated by multiplication of Table 9 and Table 10 values.

Table 12 Rates for the Tax on Real Estate Assets collection.

Land use	Rate			
	Occupied areas		Special areas	Green areas
	To enhance	To maintain		
Housing				
Pattern A	10%	10%	10%	10%
Pattern B	8%	8%	8%	8%
Pattern C	2%	2%	2%	2%
Pattern D	0%	0%	0%	0%
Commercial/Services				
Pattern A	15%	15%	15%	15%
Pattern B	10%	8%	8%	8%
Pattern C	6%	6%	6%	6%
Pattern D	0%	0%	0%	0%
Leisure	10%	10%	10%	10%

Table 13 Recoverable collection of the Tax on Real Estate Assets due to the enhanced built surfaces of the properties inside the influenced area in the “with investments” context.

Land use	Recoverable collection (R\$1,000)				
	Occupied areas		Special areas	Green areas	Total
	To enhance	To maintain			
Housing	80,116	5,114	0	0	85,230
Pattern A	41,050	2,135	0	0	43,184
Pattern B	35,577	2,668	0	0	38,245
Pattern C	3,489	311	0	0	3,801
Pattern D	-	-	-	-	-
Commercial/Services	88,438	6,096	0	0	94,534
Pattern A	44,131	3,243	0	0	47,373
Pattern B	35,305	2,075	0	0	37,380
Pattern C	9,003	778	0	0	9,781
Pattern D	-	-	-	-	-
Leisure	10,233	1,330	-	-	11,564
Total	178,787	12,541	0	0	191,328

The rates were reduced to 45% and 52.5% of the Table 11 values, respectively for the Habitational uses and Commercial/Services, as an authors' assumption for the underestimation of the real estate's market prices and the under-reporting of the real estate assets values.

Table 14 IPTU collection due to the enhanced built surfaces of the properties inside the influenced area.

Land use	IPTU collection (R\$)				
	Occupied areas		Special areas	Green areas	Total
	To enhance	To maintain			
Housing	6,897,464	471,982	4	12	7,369,462
Pattern A	2,627,188	136,614	1	4	2,763,807
Pattern B	3,035,862	227,690	2	5	3,263,559
Pattern C	1,116,555	99,614	1	3	1,216,173
Pattern D	117,859	8,064	0	0	125,923
Commercial/Services	11,841,161	902,754	6	3	12,743,925
Pattern A	4,236,551	311,294	2	1	4,547,849
Pattern B	5,083,862	373,553	3	1	5,457,419
Pattern C	2,160,641	186,777	1	1	2,347,420
Pattern D	360,107	31,129	0	0	391,237
Leisure	1,473,583	191,566	-	-	1,665,149
Total	20,212,208	1,566,301	11	15	21,778,535

The ICMS (additional added value tax on goods and services) and ISSQN (tax services of any nature) collection due to construction activities in the private properties inside the influenced area were supposed to be a function of the real estate assets profits resulting from those constructions. Calculation of this value is displayed on Table 15.

7. ISSQN (Additional Collection of the Tax on Services of Any Nature) Due to the Generation of Services Activities in the Enhanced Built Surfaces

The income from the additional ISSQN collection due the generated services activities inside the enhanced built surfaces of the influenced area of the Belo Horizonte's Metro Line 1 was assumed as a function of the real estate's market prices of the Commercial, Services and leisure properties where built surfaces have increased due to Line 1 investments and expansion. An estimation of this function was provided by the result of the division of the total collected ISSQN's amount inside the influenced area in 2007, by the real estate market prices in the same year. The calculation details are in Table 16.

8. Financial Cashflow Analysis of the Recovered Taxes Collected Income Due to the Investments on the Expansion and Improvement of the Belo Horizonte's Metro Line 1

A cash flow has been prepared in order to estimate the whole amount of recoverable tax collection by Line 1 improvement and expansion. Firstly, the annual installments were assumed as a linear distribution of the total real estate's rising prices rate percentage over the considered time period (in current values).

$$p_n = \frac{VC_N \times n}{\sum_{n=1}^N n}$$

where,

p_n = installment of year n ;

VC_N = total current value of period N ;

N = 10 years.

Cash flow present values were set with an 11.64% annual discount rate (reference rate practiced by BNDES in project financing), during a 10 years Table 17 displays the current values recoverable taxes cash flows, their present values and the net total present value.

Table 15 Determination of the recoverable ICMS and ISS collection due to the construction works of the enhanced built surfaces inside the influenced area of the Belo Horizonte's Metro Line 1.

(a) Assumed real estate assets prices for fiscal purposes.

Land use	Tax collection reduction rates due to			Reduction factor	Assets prices for fiscal purposes (R\$ 1,000)
	Real estate's market prices (R\$ 1,000) ^a	Underestimation of market prices ^b	Under-reporting ^b		
Housing	2,558,841	75%	40%	45.0%	1,151,478
Commercial, services and leisure	1,905,962	75%	30%	52.5%	1,000,630
Total					2,152,108

^a According to calculations in Table 11.

^b Estimations by the authors.

Composition of the real estate's assets prices for fiscal purposes	Percentage ^a	Share (R\$ 1,000)
Total assets prices		2,152,108
Profits from the construction activities	40%	860,843
Cleared land prices + Construction works costs		1,291,265
Cleared land prices	15%	193,690
Construction works cost		1,097,575
Labor force	40%	439,030
Construction materials		658,545

^a Values proposed by the authors.

(b) ICMS collection due to Line 1 improvement and expansion.

Tax collection sources	Collection tax share by source		Tax collection rates ^a	Fiscal income (R\$ 1,000)
	Share rate ^a	Shared amount (R\$ 1,000)		
Construction materials purchased outside the state of Minas Gerais	40%	263,418	8%	21,073
Construction materials purchased within the state of Minas Gerais	60%	395,127	16%	63,220
Total		658,545		84,294

^a Values proposed by the authors.

Beneficiaries from ICMS collection	Collection income share ^a	Shared income (R\$ 1,000)
State's Government	75%	63,220
Municipalities	25%	21,073
Belo Horizonte	12.4%	2,603
Betim	2.0%	427

Shared ICMS fiscal income by the state of Minas Gerais, Belo Horizonte and Betim (R\$ 1,000) 66,250

 ICMS collection percentage to cover Line 1 investments^a 40%

ICMS collected amount to cover Line 1 investments (R\$ 1,000) 26,500

^a Values proposed by the authors.

(c) ISS collection due to Line 1 improvement and expansion.

Construction works cost (R\$ 1,000)	1,097,575
ISS rate collected from construction activities	5%
ISS collection from construction activities (R\$ 1,000)	54,879
ISS collection percentage to cover Line 1 investments ^a	40%
ISS collected amount to cover Line 1 investments (R\$ 1,000)	

^a Values proposed by the authors.

(d) Summary of fiscal income from ICMS and ISS collection to cover the investments for the expansion and improvement on Belo Horizonte's Metro Line 1.

Fiscal source	Recoverable amount (R\$)
ICMS	26,500,164
ISS	21,951,507
ICMS and ISS	48,451,671

Table 16 Determination of the recoverable ISSQN collection due to the generation of services activities inside the influenced area of the Belo Horizonte's Metro Line 1.

(a) Average real estate's market prices inside the influenced area, in the "with investments" context.

Land use	Average prices (R\$ / m ²)			
	Occupied areas		Special areas	Green areas
	To enhance	To maintain		
Housing				
Pattern A	1,200	1,200	1,200	1,200
Pattern B	800	800	800	800
Pattern C	500	500	500	500
Pattern D	200	200	200	200
Commercial/Services				
Pattern A	2,500	2,500	2,500	2,500
Pattern B	1,500	1,500	1,500	1,500
Pattern C	1,000	1,000	1,000	1,000
Pattern D	500	500	500	500
Leisure	1,000	1,000	1,000	1,000

Values obtained by the reduction of a supposed 20% profit during the considered period of analysis from the Table 10 values.

(b) Real estate market prices of the properties inside the influenced area by the Belo Horizonte's Metro Line1, in the "without investments" context in 2007.

Land use	Real estate prices (R\$ 1000)			
	Occupied areas		Special areas	Green areas
	To enhance	To maintain		
Housing				
Pattern A	2,058,826	6,828,438	1,186	3,557
Pattern B	760,182	1,976,473	390	1,170
Pattern C	878,432	3,294,121	520	1,559
Pattern D	380,091	1,441,178	244	731
Pattern D	40,121	116,667	32	97
Commercial/Services				
Pattern A	1,354,277	4,975,495	707	353
Pattern B	466,992	1,715,688	244	122
Pattern B	560,390	2,058,826	292	146
Pattern C	280,195	1,029,413	146	73
Pattern D	46,699	171,569	24	12
Leisure	324,864	1,055,808	14,132	3,005
Total	3,737,966	12,859,741	16,024	6,916

Values obtained from the multiplication of the existing built surfaces in 2007 (Table 6) by the average real estate's market prices from Table 16a.

(c) IPTU's total collection estimates due to existing properties inside the influenced area in 2007, in the "without investments" context.

Land use	Annual IPTU's collection (R\$ 1,000)				
	Occupied areas		Special areas	Green areas	Total
	To enhance	To maintain			
Housing	5,929	19,666	3	10	25,609
Pattern A	2,189	5,692	1	3	7,886
Pattern B	2,530	9,487	1	4	12,023
Pattern C	1,095	4,151	1	2	5,248
Pattern D	116	336	0	0	452
Commercial/Services	10,238	37,615	5	3	47,861
Pattern A	3,530	12,971	2	1	16,504
Pattern B	4,237	15,565	2	1	19,805
Pattern C	2,118	7,782	1	1	9,902
Pattern D	353	1,297	0	0	1,650
Leisure	2,456	7,982	107	23	10,567
Housing	18,624	65,263	116	36	84,038

Values obtained from the multiplication of the Table 16b values by the factors of 0.29% for housing, and 0.76% for the commercial, services and leisure properties, as described for the tax on real estate assets evaluation.

(d) ISSQN's total collection estimates due to the generation of services activities inside the influenced area in 2007, in the "without investments context".

Determination of the percentage of the Belo Horizonte's IPTU's estimated collected total amount due to the properties inside the influenced area	
IPTU's collected amount inside the influenced area in 2007 (R\$)	84,037,502
Total IPTU's collected amount in Belo Horizonte in 2007 (R\$) ^a	691,859,577
Percentage of total IPTU's collection due to the properties inside the influenced area in 2007	12.1%

^a Estimated amount by extrapolation from the actual collected amount in 2005.

Estimation of ISSQN's annual collection inside the influenced area	
ISSQN's total collected amount in Belo Horizonte in 2007 (R\$) ^a	463,936,000
Estimated percentage of ISSQN's collected amount inside the influenced area in 2007 ^b	9.3%
ISSQN's estimated collected amount inside the influenced area in 2007 (R\$)	43,348,083

^a Values from Table 16b.

^b Values from Table 11.

(e) Determination of the recoverable ISSQN collection due to the generation of services activities in the enhanced built surfaces of the properties used for commercial, services and leisure purposes inside the influenced area.

Topic	Unit	Value
ISSQN's estimated collected amount inside the influenced area in 2007 (R\$)	R\$	43,348,083
Former real estate market prices in 2007, in the "without investments" context ^a	R\$	7,728,640,445
ISSQN's estimated collection / real estate market prices	R\$/R\$	0.00561
Assumed ratio for the exercise's purposes		0.50%
Real estate market prices of the enhanced built surfaces due to the investments on Line 1 ^b	R\$ 1,000	1,905,962.12
Annual ISSQN collected additional amount due to the investments	R\$	9,529,810.58

^a Values from Table 16b.

^b Values from Table 11.

Table 17 Present values of the recoverable taxes due to the expansion and improvement of the Belo Horizonte Metro's Line 1.

Recoverable taxes	Present values	Current values (R\$ 10 ⁶)										
		Total	Year									
			2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Tax on Real Estate Assets	102.7	191.3	3.5	7.0	10.4	13.9	17.4	20.9	24.4	27.8	31.3	34.8
IPTU	3.5	6.5	0.1	0.2	0.4	0.5	0.6	0.7	0.8	1.0	1.1	1.2
ICMS + ISS	26.0	48.5	0.9	1.8	2.6	3.5	4.4	5.3	6.2	7.0	7.9	8.8
ISSQN	5.1	9.5	0.2	0.3	0.5	0.7	0.9	1.0	1.2	1.4	1.6	1.7
Total	137.3	255.8	4.7	9.3	14.0	18.6	23.3	27.9	32.6	37.2	41.9	46.5

9. Conclusions

This work presents an estimation of value capture as a strategy to be explored to expand the potential resources to finance public transport infrastructure. In that sense, the capitalization of the financial benefit, specifically its recoverable share by the government, would be a more consistent way for such financing. It opposes the real estate's expansion and higher prices inside the infrastructure influenced area to tax payers' collective charges, even if they would be, directly or indirectly, their beneficiaries. In particular, assuming the very likely hypothesis that it would be up to the Government carry out the infrastructure's implantation capital expenditures, the central question to be studied was the evaluation of how much the bigger tax collected amount, exclusively due to the financial benefits, could recover a part of the spent public resources.

The viability of the fiscal capture of the real estate market's growth was simulated for the Belo Horizonte Metro's Line 1, starting from the concept of value capture from the benefit due to its expansion and improvement, as base as a basis for obtaining resources for the infrastructure's implementation and operation.

More specifically, the following revenues were analyzed: (1) the potential recovery of the collection of a tax on real estate assets inside the Line 1 influenced area; (2) the additional Urban Property Tax collection corresponding to the enhanced built surfaces inside the influenced area; (3) the ICMS (Circulation of Goods and Services Tax) and the ISS (Service Tax) collection corresponding to the

construction activities in the enhanced built surfaces of the influenced area; (4) the ISSQN on behalf of the generated service activities in the enhanced built surfaces of the influenced area.

The foreseen investments on Line 1 were fleet acquisition, signaling system, maintenance equipments, systems and equipment, technical assistance, studies and projects, construction/ rehabilitation of stations, construction of a new Bus Station and of the expressway to the new State's Government's Administrative Center. The total expenditure will be around R\$ 326.7 million. The exercise's simulations show, in conservative way, that it would be possible to recover a significant portion such total expenditure, about R\$ 137.3 million, 42% of the total.

The first main share, about 75% of the recoverable amount, would be provided by the potential collection of the tax on real estate's assets. It is a proof of the value capture moral basis: the unequivocal real estate's higher market prices of some beneficiary properties.

The other main share, about 19% of the total amount, comes from the recoverable ICMS and ISS collected share concerning the construction activities to enhance the built surfaces. Finally, the property tax and ISSQN share is approximately 7% of the captured value.

Financing public transport infrastructures as metro lines by means of the value capture provided by its implementations is also a regulatory and urban management tool, because it can be used to control the infrastructure's impacts on the real estate's market prices.

References

- [1] J. Barat, *The Evolution of Transportation in Brazil*, Brazilian Institute of Geography and Statistics/Institute of Economic and Social Planning, Rio de Janeiro, 1978, p. 385. (in Portuguese)
- [2] J.J.G. Aragão, *Principles for Territorial Engineering*, Discussion Paper No. 2, CEFTRU/UNB—Center for Human Resources Training in Transportation, Brasília, 2008. (in Portuguese)
- [3] D. Aschauer, *Is public expenditure productive?*, *Journal of Monetary Economics* 23 (1989) 177-200.
- [4] The World Bank, *World Development Report 1994, Infrastructure for Development*, Washington, 1994.
- [5] W. Lu, *Public Infrastructure and Regional Economic Development: Evidence from China*, Pacific Economic Paper 258, The Australian National University, Canberra, 1996.
- [6] D. Banister, Y. Berechman, *Transport investment and the promotion of economic growth*, *Journal of Transport Geography* 9 (3) (2001) 209-218.
- [7] OCDE—Organization for Economic Co-operation and Development, *Impact of Transport Infrastructure Investment on Regional Development*, Paris, 2003.
- [8] A. Estache, M. Fay, *Current Debates on Infrastructure Policy*, Policy Research Working Paper 4410, The World Bank, Washington, 2007.
- [9] F.J. Rigolon, M.S. Piccinini, *The Infrastructure Investment and Resumption of Sustained Economic Growth*, Sector Discussion Paper No. 63, BNDES, Rio de Janeiro, 1997. (in Portuguese)
- [10] P.C. Ferreira, T.G. Milliagros, *Impacts on productive infrastructure in Brazil, 1950/95*, *Research and Economic Planning* 28 (2) (1998) 315-338. (in Portuguese)
- [11] R.M. Benitez, *Infrastructure, its relationship to total factor productivity and its effects on regional product*, *Planning and PPP (Public Policy Review)* 19 (1999) 275-306. (in Portuguese)
- [12] J.O. Cândido, *Public spending in Brazil is productive?*, *Planning and Public Policy Review* 23 (2001) 233-260. (in Portuguese)
- [13] F. Rocha, A.C. Giuberti, *Composition of Public Expenditure and Economic Growth: A Panel Study for Brazilian States*, 2006, <http://www.anpec.org.br/encontro2005/artigos/A05A049.pdf> (accessed Aug. 9, 2006). (in Portuguese)
- [14] A. Pedler, *A Transport Planners' Guide to Capturing Land Value Uplift*, Transport Planning Society, 2003, <http://www.tps.org.uk/activities/bursaries/bursary2003.htm> (accessed Jan. 1, 2012).
- [15] H. Dittmar, G. Ohland, *The New Transit Town, Best Practices in Transit-Oriented Development*, Island Press, Washington, 2004.
- [16] D. Belzer, G. Autler, *Transit Oriented Development: Moving from Rethoric to Reality*, Discussion Paper, The Brookings Institution Center on Urban and Metropolitan Policy, Washington, 2002.
- [17] R. Cervero, C. Ferrell, S. Murphy, *Transit-Oriented Development and Joint Development in the United States, A Literature Review Research Results Digest 52*, Transportation Research Board, Washington, Oct. 2002.
- [18] R. Cervero, S. Murphy, C. Ferrel, N. Goguts, Y.H. Tsai, *Transit Oriented Development in the United States: Experiences, Challenges and Prospects*, TCRP Report 102, Transportation Research Board, Washington, 2004.
- [19] J.J. Smith, T.A. Gihring, *Financing transit systems through value capture: An annotated bibliography*, *The American Journal of Economics and Sociology* 65 (3) (2006) 751-786.
- [20] M. Enoch, S. Potter, S. Ison, *A strategic approach to financing public transport through property value*, *Public Money and Management* 25 (3) (2005) 147-154.
- [21] V.C. Lima Neto, *A methodology for estimating the surplus value of property resulting infrastructure interventions in public transport*, Master Thesis, Faculty of Engineering, Department of Civil and Environmental Engineering—UNB Brasília, 2006. (in Portuguese)
- [22] M.L. Piza, P. Santoro, R. Cymbalista, *City Statute: A Reading from the Perspective of Recovery of Land Valuation*, in: P. Santoro (org.), F. Furtado, M.L. Piza, M.O. Smolka, R. Cymbalista (Eds.), *Social Management of Land Appreciation*, Polis, São Paulo, 2004. (in Portuguese)
- [23] FJP—João Pinheiro Foundation, *Center for Statistics and Information of João Pinheiro Foundation (CEI/FJP)*, 2009, http://www.fjp.mg.gov.br/index.php?option=com_content&task=view&id=875&Itemid=97 (accessed July 22, 2009). (in Portuguese)
- [24] IBGE—Brazilian institute of Geography and Statistics, 2008, <http://www.ibge.gov.br/cidadesat/topwindow.htm?1> (accessed Feb. 10, 2008). (in Portuguese)