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The Effectiveness of the Business Intelligence Model on the Production Leap in Hamedan Province

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Abstract

Purpose: Due to its socio-cultural effects, the development of communication technologies—and the consequent growth of areas such as the innovative economy—has become one of the most significant drivers of change within the economic sector and business landscape. The digital economy has fundamentally transformed how companies produce and market goods and services, giving rise to new business models across various industries. This study seeks to analyze the effectiveness of business intelligence adoption in Hamedan Province.

Method: This research examines variables including per capita GDP growth, number of internet users, population growth rate, gross fixed capital formation, government consumption expenditure, mobile cellular subscriptions, and fixed broadband subscriptions.

Findings: Analysis of key variables indicates that innovative economic indicators, along with increases in government consumption expenditure, positively contribute to economic growth in Hamedan Province. Moreover, shocks in gross capital formation within most business environments are found to stimulate economic growth, supporting long-term development in the region.

Conclusion: The interdependence of economic sectors and their growing reliance on information and communication technologies emphasize the

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crucial role of an innovation-driven economy in the province's development. These findings highlight the urgency of integrating technological innovation to foster production growth.

Keywords: Smart Economy, Business, Production, Information and Communication Technology, Vector Autoregressive

Introduction

An innovative and knowledge-based economy is fundamentally structured around intelligent technologies, including computing systems, software, and various information technologies (Liu et al., 2023; Johannessen, 2023). Such an economy drives transformation and enhances efficiency across all stages of the organizational value chain, as well as within diverse business models. Intelligentization refers to the socio-technical developments arising from the broad integration of technologies capable of gathering, processing, and disseminating large volumes of information (Turaev et al., 2023).

However, Hamedan province faces significant structural challenges, including underdeveloped industrial and production sectors, outdated and inefficient agricultural practices, and the proliferation of informal—and at times illicit—employment within the tourism industry (Babaei, 2020). These issues have contributed to rising unemployment and socioeconomic instability across the region.

Furthermore, the demographic distribution—particularly among the youth and educated segments of the population—coupled with a lack of adequate business infrastructure tailored to their skills, has resulted in substantial outmigration of talented and educated individuals to provinces such as Tehran and Alborz. Concurrently, the growth of service-oriented businesses, especially in tourism, has attracted unskilled and less-educated laborers to cities like Hamedan and Bahar. This dynamic has created an imbalanced structure of labor supply and demand, exacerbating regional disparities (Heidarian et al., 2016).

Figure 1. Distribution of Jobs and Businesses in Hamadan Province

(Source: Ministry of Cooperatives, Labor, and Social Welfare, 2020)

According to the topic of the research, it can be said that the priority fields for the development of production growth in Hamadan about intelligentization business can be classified as follows:

Table 1. Classification of Jobs in Growth Priority for the Intelligentization of Hamadan Province

Field Name	Employment Capacity
Tourism	3900
Sofa and wood	3400
Clothing	3000
Agricultural processing industries	5400
Handicrafts and pottery	2000

(Source: Mehr News Agency, 2019)

Global economic and business trends are increasingly shaped by innovative technologies, underscoring the urgency of strategic investment in these areas (Hassoun et al., 2023). Given Hamedan Province's above-average standing in the business environment and the development of a comprehensive provincial information technology plan, targeted investment in innovative production and service technologies could significantly enhance output, reduce costs, and improve product quality (Babaei, 2020).

A review of existing literature reveals a lack of comprehensive and consensus-driven research on the role of the innovative economy in fostering production growth and improving the business environment in Hamedan. Few studies have systematically examined the economic dimensions of intelligentization within the province. This study aims to address this gap by evaluating the effectiveness of a business intelligence model tailored to Hamedan's context—a subject that, to date, has received limited scholarly attention.

By leveraging technology and moving toward smarter urban management—particularly through collaboration between the municipality, governor's office, and provincial government—this research seeks to support more efficient, deliberate, and higher-quality urban governance. The COVID-19 pandemic highlighted the tangible benefits of smart city infrastructure, demonstrating the critical need for remote work capabilities and digital service delivery via web and social media platforms (Imna, 2021). These developments reinforce the relevance and timeliness of this study.

Literature Review

The study by Kajtazi et al. (2023) offers valuable insights into the relationship between business model innovation and corporate sustainability within the Western Balkan context. Although the paper does not explicitly address the intelligentization of the economy, it underscores the importance of innovation and creativity in shaping sustainable business models. Employing a quantitative methodology and Partial Least Squares Structural Equation Modeling (PLS-SEM), the authors provide rigorous empirical support for their hypotheses. Their geographically focused analysis contributes meaningful perspectives for academics, practitioners, and policymakers interested in how innovative business models can advance corporate sustainability. That said, the absence of a direct focus on economic intelligentization presents an opportunity for further research.

Antonov et al. (2022) provide a comprehensive review of factors driving change in contemporary economic systems and the emergence of new business models. The authors emphasize the transformative role of technological capabilities in reshaping production processes, globalizing markets, and fostering collaborative entrepreneurship. Their work offers pertinent insights for those examining the intersection of business model innovation and corporate sustainability. However, like Kajtazi et al. (2023), this study does not deeply engage with the concept of economic intelligentization, indicating a gap for future investigation.

Research on smart cities and regions has traditionally emphasized integrated components such as the innovative economy, smart environment, intelligent citizens, smart living, smart mobility, and smart governance. While numerous studies have explored the influence of individual economic indicators on specific smart domains, few have considered their mutual interdependencies. Popova and Popovs (2022) addressed this gap by examining both the direct effects of an innovative economy on other smart components and the indirect influence of broader national economic indicators. Using PLS-SEM analysis on data from Eurostat and the Latvian Statistical Office (2009–2019), their results demonstrated that an innovative economy directly enhances smart people, smart living, smart mobility, smart environment, and smart society. Additionally, mediation effects through national economic indicators were confirmed only for the smart society domain. These findings offer practical guidance for authorities pursuing sustainable development of smart regions, particularly in contexts with emerging rather than advanced economic foundations.

The role of digitalization in business sector development within knowledge economies has also garnered significant academic attention. Neamţu et al. (2019 emphasized technology's capacity to revolutionize communication and improve efficiency across sectors, underscoring the disruptive power of digital innovation. Their study evaluated theoretical approaches to the information society and quantified digital progress in Romania and the broader European context using international indicators such as the ICT Development Index (IDI) and the Digital Economy and Society Index (DESI). By situating Romania within global ICT rankings, the authors shed light on how digital transformation shapes business environments—laying important groundwork for future studies on technological advancement and economic development.

Together, these studies highlight the growing relevance of technological innovation, digitalization, and intelligent systems in shaping modern economies and business practices, while also pointing toward unresolved questions regarding the intelligentization of regional economies such as that of Hamedan Province.

Purpose of the Study

This study aims to conduct a comprehensive analysis of the business intelligentization model and its potential to address structural economic gaps in Hamedan Province. By identifying and clarifying the challenges faced by key economic sectors, this research underscores the urgent need for innovative technologies and modern approaches capable of enhancing productivity, reducing unemployment, and stimulating sustainable economic growth.

A thorough understanding of these issues is essential to emphasize the importance of transitioning toward an innovation-driven economy that effectively leverages technology for regional development and improved quality of life. Ultimately, this research intends to support the formulation of evidence-based policies and strategies that promote sustainable economic growth, a balanced labor market, and an enhanced business environment in Hamedan Province.

Theoretical Foundations

Economic growth is defined as a sustained increase in a society's national income or gross national product over a specific period. More precisely, it refers to a quantitative rise in production during a given timeframe compared to a previous period. Theoretical models of economic growth

have been developed to interpret and explain empirical observations in global economic development (Hajian, 2023). Studies in this field are historically and methodologically divided into three major streams:

Classical Growth Model:
Rooted in Keynes' static short-term equilibrium framework, the classical growth model was advanced independently by Harrod and Domar between 1934 and 1936. Their approaches emphasized capital accumulation, labor force expansion, and technological progress as key drivers of growth (Nihal et al., 2023; Giroire et al., 2023).

Harrod-Domar Growth Model:
As one of the first models to analyze long-term economic behavior, the Harrod-Domar model introduces the concept of a "warranted" growth rate. Under equilibrium conditions, output must grow at this rate to ensure full employment of capital and labor (Le-Van & Tran-Nam, 2023).

Neoclassical Growth Model:
Proposed by Robert Solow and Trevor Swan in 1956, the neoclassical model retains many assumptions of the Harrod-Domar framework but introduces a production function with constant returns to scale. This model has become a benchmark for understanding capital deepening and technological change in growth theory (Nihal et al., 2023; Kian Poor & Tavalaei, 2014).

Endogenous Growth Model:
This approach argues that long-term growth is generated within the economic system itself, rather than from exogenous technological progress. Endogenous models highlight the roles of human capital, innovation, and policy in sustaining growth. Three main strands emphasize respectively: externalities from physical capital accumulation, human capital development, and the continuous creation of new production designs and technologies. The third approach is particularly influential in explaining sustained economic expansion (Nihal et al., 2023; Kruse-Andersen, 2023).

Foundations of the Innovative Economy
The concept of the innovative economy was first introduced by Don Tapscott in 1995. Since then, it has become a central idea in modern

business and economic discourse. From the late 20th century onward, intelligence-driven technological change began transforming societies—with the economic sphere experiencing particularly profound shifts, subsequently influencing cultural and political domains (Skvarciany et al., 2023).

According to the International Monetary Fund, an innovative economy involves the application of intelligent technologies to redesign economic processes—including production, governance, household activities, and financial systems. It is not a static concept but an evolutionary outcome of earlier economic paradigms: the information economy of the 1970s, the knowledge-based economy of the 1980s, the modern digital economy of the 1990s, and the network and internet economy of the 2000s (Liu & Wu, 2023).

Table 2. Increase in GDP due to Broadband and Internet Penetration

Researcher	Countries Studied	Years Studied	GDP Growth
Kotrompis (2009)	22 member countries of OECD	2004-2007	0.6
Zenrich (2009)	25 member countries of OECD	1996-2007	0.6
Zabaros and Rivas (2012)	26 countries in Latin America and the Caribbean	2003-2009	3.2
Kayant (2009)	120 developed countries 120 developing countries	1980-2006 1980-2006	1.28 1.38
Scott (2012)	120 developed countries 120 developing countries	1980-2006 1980-2006	1.19 1.35

(Source: Hernandez et al., 2019)

Method

Endogenous growth theory emphasizes the central role of technological innovation in driving sustained economic development. In alignment with Solow's neoclassical model, long-term increases in living standards are primarily attributable to technological progress and intelligentization. Grounded in these theoretical foundations and supported by empirical studies, this research adopts the World Bank's development indicators and

the framework proposed by Godwin (2019). The analytical model is further informed by the seminal works of Datta and Agarwal (2004), Barro (1991), and Levine and Renelt (1992).

Given the focus on intelligentization and constraints related to data availability in the context of Hamedan Province, the following econometric model has been formulated:

GDPPC=f (intuser, popgr, gdi, gc, Mobsub, brb)

Table 3. Explanation of Variables

Variable name	Description
GDP growth per capita (GDPPC) (Dependent)	GDP divided by population
Internet users (infuser)	Percentage of people who use the Internet.
Population growth rate (popgr)	The annual population growth rate for year t is the mid-year exponential population growth rate from year t-1 to t
Gross domestic investment (gdi)	Gross domestic investment includes land improvement, machinery, and road construction
Government consumption (gc)	include all current expenses of the government for the purchase of goods and services
Mobile subscription (Mobsub)	Mobile phone subscription per 100 people
Broadband subscriptions (brb)	Fixed broadband subscriptions per 100 people

Statistical Population

In this research, government sectors and public sectors (areas in which the government is involved, such as public health services, transportation, public infrastructure, maintaining order and peace and national security, citizen services or regulation) and public industries (water and electricity, etc.) has been used in Hamedan province that has benefited from the innovative and intelligent economy. The time series variables in Hamadan province are time series from 2013 to 2023.

Method of Collecting Information

All data required for this research were obtained from the Office of Future Studies, Modeling, and Economic Information Management; the National Portal of Statistics; the Hamedan Provincial Directorate of Industry,

Mining, and Trade; the Hamedan Provincial Treasury Department; and the Hamedan Investment Service Center. Data collection was conducted through official websites as well as direct correspondence with the relevant institutions.

Data Analysis Method

In this research, econometric methods are used to estimate patterns; in this way, using Eviews, the data were analyzed using a vector regression method.

Findings

Prior to model estimation, a series of diagnostic tests were conducted to ensure the robustness and validity of the regression results. To avoid spurious regression, a unit root test was performed to assess the stationarity of the variables. Additionally, a cointegration test was employed to examine long-term relationships among the variables. Finally, the model was estimated, and impulse response functions were generated to analyze the dynamic responses of the variables to economic shocks.

Checking the Stationarity of Variables

The analysis of time series assumes that they are Stationary. The generalized Augmented Dickey-Fuller (ADF) unit root test was used to check the normality of the time series.

Table 4. Augmented Dickey Fuller (ADF) Results

Variables	Critical values			ADF	Stationary
	1%	5%	10%		
gdppc	-4.252879	-3.548490	-3.207094	-1.545446	stationary with first difference
intuser	-3.639407	-2.951125	-2.614300	-0.172789	stationary with first difference
mobsub	-3.661661	-2.960411	-2.619160	1.252141	stationary with first difference
popgr	-3.646342	-2.954021	-2.615817	-1.243979	stationary with first difference
gdi	-2.641672	-1.952066	-1.610400	-0.534226	stationary with first difference
gc	-3.661661	-2.960411	-2.619160	2.214605	stationary with first difference
brb	-4.252879	-3.548490	-3.207094	-1.244316	stationary with first difference

The analysis confirms that all variables achieve stationarity after first differencing. Also, to eliminate the autocorrelation between the disturbance sentences, the optimal interval length is considered using the Schwarz-Bayesian criterion because this criterion selects the least expensive model.

Table 5. Optimal Lag Length

Lag	LOGL	AIC	SC	HQ
1	-90.92479	9.027405	11.29403	9.766269
2	-38.28956	8.792875	13.32612	10.27060

According to the estimation, it is determined that the Optimal Lag Length is 1. Also, one of the most basic tasks in the VAR model is to check the stability of the model based on the roots of the characteristics. All the roots of the characteristics are inside the circle and less than one, which indicates that the model is stable.

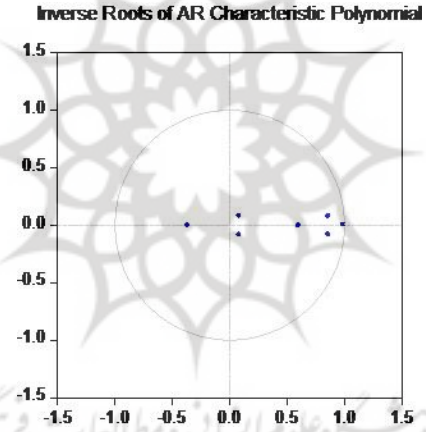

Figure 2. Stability of the Model Based on the Root of Characteristics

After determining the stability of the model, it is necessary to examine the self-consistency of the model, which can be observed that the model has self-inconsistency in the optimal lag:

Table 6. Autocorrelation Test in Optimal Lag based on LM Test

Lag	df	Prob	RAO F-stat	df	Prob
1	49	0.3305	1.081749	(49.65.3)	0.3798
2	49	0.6767	0.853955	(49.65.3)	0.7166

Also, Portman test according to Box-Pierce-Ljung-Box Q statistics, proves that residuals have no autocorrelation in this optimal lag and lags greater

than one have serial autocorrelation.

Table 7. Autocorrelation Test of Model Residuals based on Portmanteau

Lag	Q-STAT	PROB	Adj Q-stat	PROB	df
1	33.70710	-	34.79443	-	-
2	80.61484	0.0030	84.82935	0.0011	49

According to Table 8, it was found that the model has homogeneity of variance:

Table 8. VAR Model Variance Homogeneity Test

Joint Test		
Prob	**df**	**Chi-sq**
0.2719	392	402.5616

After completing these steps, the normality of the data should be checked, but due to the small number of samples, the Jarque-Bera test cannot be used. Therefore, the quantile-quantile test is used for the model's residuals, and it is determined that the model is standard.

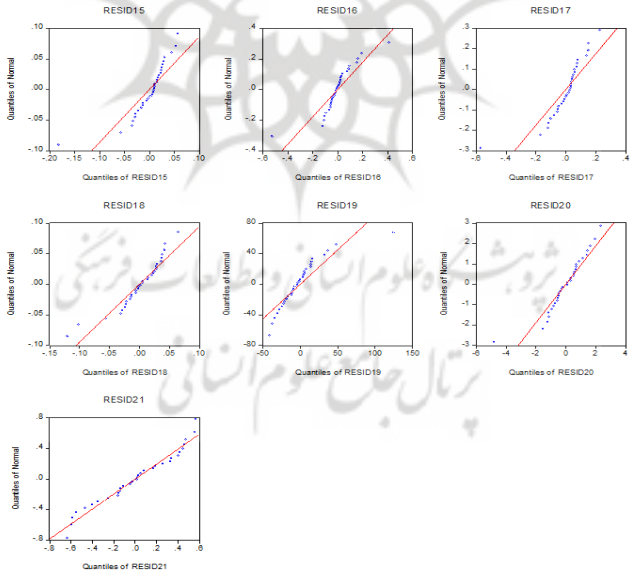

Figure 3. Data Normality Test of Research

Johansson Convergence Test

To examine the existence of long-term relationships among the variables, the Johansen cointegration test was employed. The key distinction between the Engle–Granger and Johansen cointegration tests lies in their treatment of cointegrating vectors: the Engle–Granger approach assumes a single cointegrating vector, whereas the Johansen method allows for multiple cointegrating vectors in multivariate systems. The Johansen-Juselius test enables the identification of the number of cointegrating relationships present among the variables.

Two test statistics—the trace test and the maximum eigenvalue test—are used to determine the number of cointegrating vectors. The decision to reject or fail to reject the null hypothesis is based on a 95% confidence level. Specifically, the null hypothesis is rejected if the test statistic exceeds the critical value; if the test statistic is lower than the critical value, the null hypothesis cannot be rejected.

Table 9. Convergence Test (Trace)

Hypothesizd No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob
None *	0.848105	162.1628	111.7805	0.0000
At most 1*	0.751707	103.7413	83.93712	0.0009
At most 2*	0.550625	60.55374	60.06141	0.0454
At most 3	0.424443	35.75690	40.17493	0.1299
At most 4	0.310381	18.63197	24.27596	0.2182
At most 5	0.179522	7.111857	12.32090	0.3141
At most 6	0.310540	0.977926	4.129906	0.3742

Table 10. Convergence Test (Maximum Eigenvalue)

Hypothesizd No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob
None *	0.848105	58.42152	42.77219	0.0005
At most 1*	0.751707	43.18756	36.63019	0.0074
At most 2	0.550625	24.79684	30.43961	0.2143
At most 3	0.424443	17.12493	24.15921	0.3333
At most 4	0.310381	11.52011	17.79730	0.3390
At most 5	0.179522	6.133931	11.22480	0.3347
At most 6	0.310540	0.977926	4.129906	0.3742

The results show that the resulting estimate has a long-term relationship; according to both tests, there is precisely one convergence vector. Therefore, we can enter all the variables into the model and estimate the long-term relationship between the variables.

Table 11. Estimation of the VECM Relationship

GDPPC	GDI(-1)	POPGR(-1)	BRBI(-1)	MOBSUB(-1)	INTUSER(-1)	GC(-1)
Coefficients	0.311857	-0.000729	-0.077082	1.8021018	0.432668	-0.495309
Standard errors	0.06203	0.00191	0.04895	0.42655	0.24757	0.14487
T-statistics	-5.02786	0.38248	1.57459	-4.22468	-1.74756	3.41905

Impulse Response Function

The impulse response function (IRF) analysis examines the timing and magnitude of the effects of structural shocks on the variables in the system. These functions trace the impact of a one-standard-deviation shock in one variable on the current and future values of other variables in the model. To illustrate the dynamic response of the system to shocks and to distinguish the behavior of each variable following a disturbance, the generalized impulse response method has been employed.

As clearly illustrated in Figure 4, a shock to the number of internet users and mobile phone subscriptions has a positive and sustained effect on GDP growth. In contrast, a shock to broadband subscriptions initially exerts a negative effect; however, after two periods, it begins to exhibit an increasing trend, and from the fourth period onward, it contributes positively to GDP growth. A similar pattern is observed for the population growth rate.

Furthermore, a shock to gross fixed capital formation has a negative short-term impact on GDP growth but transitions to a positive effect beginning in the fourth period. Finally, a shock to government consumption consistently demonstrates a positive influence on GDP growth throughout the observed periods.

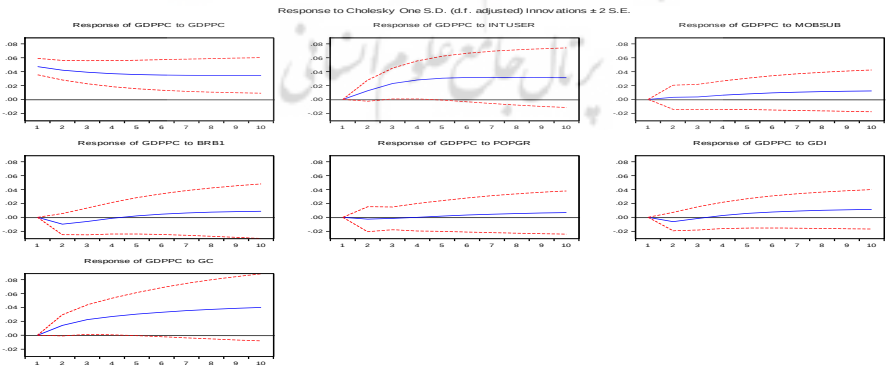

Figure 4. The Immediate Response of GDP Per Capita Growth to Shocks

Results of Analysis of Variance

Variance analysis separates changes in one variable from shocks in other variables. Therefore, variance analysis prepares information regarding the relative importance of each random shock in affecting the model's variables. In the variance analysis method, the contribution of the shocks applied to different model variables to the variance of the prediction error of a variable in the short and long term is determined.

Table 12. Variance Analysis of the GDPPC Variable

T	S.E.	GDPPC	INTUSER	MOBSUB	BRB1	POPGR	GDI	GC
1	0.047178	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.067108	88.67775	3.513758	0.210373	2.107605	0.154231	0.836300	4.499982
3	0.084386	77.59791	9.592486	0.324642	1.823577	0.128714	0.563866	9.968805
4	0.100343	68.58318	14.65903	0.605578	1.305779	0.091124	0.473127	14.28219
5	0.115432	61.50059	18.10718	0.941738	1.023046	0.096101	0.603635	17.72771
6	0.129753	56.02381	20.23174	1.275193	0.937086	0.142655	0.833074	20.55644
7	0.143386	51.75979	21.46535	1.577460	0.962882	0.218033	1.088839	22.92765
8	0.156398	48.39609	22.13409	1.843217	1.040389	0.307785	1.336811	24.94162
9	0.168857	45.70008	22.45713	2.073260	1.134885	0.402189	1.563902	26.66855
10	0.180827	43.50571	22.57336	2.271406	1.228035	0.494753	1.766488	28.16025

The results of the variance decomposition analysis for the per capita GDP growth variable are presented in Table 12. This table displays the contributions of various structural shocks to the forecast error variance of per capita GDP over different time horizons.

In the first period, the variable itself accounts for 100% of the variance in per capita GDP fluctuations. By the second period, this proportion decreases to 88%, indicating that other variables begin to contribute to the explained variance.

In the medium term, the most significant contributors to fluctuations

in per capita GDP are, in descending order: per capita GDP itself, government consumption, and internet users. By the tenth period, the share of the variable's own shocks in explaining its fluctuations declines to 43%. At this horizon, following its own innovations, transitory shocks to government consumption and internet users play the most substantial roles in accounting for variation in per capita GDP.

Conclusion

This study analyzes the effectiveness of business intelligence adoption in Hamedan Province. The primary findings from model estimation reveal that technological shocks generally exert a positive influence on per capita GDP growth, indicating that investment in this sector stimulates provincial production. The benefits of economic intelligentization manifest from both supply and demand perspectives. On the supply side, activities directly producing information and communication goods and services contribute explicitly to growth and GDP. Furthermore, investment in innovative technologies represents a form of capital that, when integrated with the business environment, fosters capital deepening and enhanced productivity across other economic sectors. Finally, smart transformation promotes economic growth by strengthening human capital through education, thereby reinforcing the provincial economy.

Consistent with the findings of Hofman et al. (2016), intelligentization supports economic growth by generating demand for digital products and encouraging investment in business environment improvements. Simultaneously, individual use of ICT contributes to provincial growth through several mechanisms: first, it serves as a platform enabling information access and knowledge dissemination, leading to broader societal empowerment; second, it generates network externalities—for instance, engagement through digital technologies like mobile phones enhances social networks and increases the perceived value of local products; third, it boosts demand for ICT-enabled goods and services, stimulating growth in the telecommunications sector; and fourth, it facilitates smarter communication, increasing market awareness of goods and services, amplifying demand, and fostering economic growth through word-of-mouth effects, as also observed in studies by Trusov et al. (2009) and Viljoen et al. (2016).

Interviews and questionnaires conducted in the ICT infrastructure sector revealed both alignment and discrepancies with model estimates. For instance, while the model indicated initial negative growth in

broadband penetration, empirical observations confirmed increased bandwidth availability resulting from effective government policies. Currently, the province possesses bandwidth capacity five times its daily requirement. However, to reduce costs, service providers have altered network sharing ratios (e.g., shifting from 1:8 to 1:30 subscriber allocations), and bandwidth restrictions due to cultural policies have further constrained effective speeds. Consequently, despite the positive potential of fixed broadband, users have increasingly turned to mobile internet due to its convenience—a trend consistent with global patterns.

Moreover, no dedicated budgetary allocation has been made for IT infrastructure development in the province, nor have funds been allocated beyond basic infrastructure—such as for digital industry imports. The absence of a comprehensive digital development strategy indicates limited adoption of smart governance among provincial managers, despite 70–80% of the population having internet access. Additionally, no investment has been made in specialized training for intelligent technologies, and no formal trade association for internet-based businesses exists in Hamedan.

Although numerous online retail stores operate in sectors such as clothing, food, cosmetics, and household goods, most remain unregistered with the Provincial Directorate of Industry, Mining, and Trade. While the province has entered the digital economy arena, businesses have been slow to adopt intelligentized practices. Digital transformation of companies requires less investment than large-scale infrastructure development; however, despite available infrastructure, resistance to digital innovation persists. Only 24 digital product types have been introduced in the province in recent years, with limited impact on intelligentization or production growth.

Studies by Solomon and van Klyton (2020) demonstrate that increased public demand and vocal engagement in online forums can drive the creation of innovative digital infrastructure in advanced economies, ultimately leading to economic growth. Similarly, research by Manyika and Roxburgh (2011) highlights the transformative effect of digital technologies on business value chains across sectors—enabling even small enterprises to participate in dynamically managed supply chains with global reach.

Given the existing infrastructure in Hamedan, low production costs for certain goods could facilitate export opportunities and integration into global value chains. Strategic policy measures and greater public-private collaboration are essential to fully realize the potential of business

intelligentization in the region.

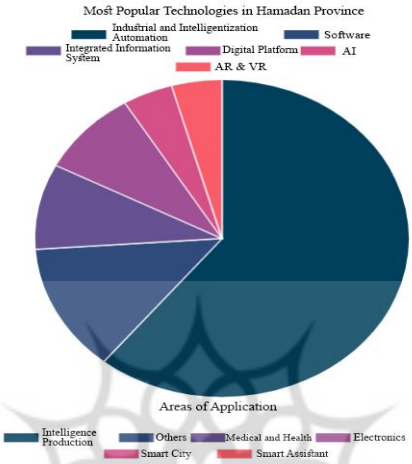

Figure 5. Most Popular Technologies in Hamedan Province

This study demonstrates that government expenditure shocks, particularly in infrastructure investment during recent periods, have positively influenced per capita GDP growth in Hamedan province while exhibiting modest positive effects on population dynamics. These findings highlight the synergistic relationship between public investment and intelligentization efforts. The research aligns with Acemoglu and Zilibotti's (2001) theoretical framework, confirming that developing a skilled workforce in digital technologies creates favorable conditions for economic growth. Accordingly, Hamedan province should implement both short-term and long-term educational programs to enhance digital literacy and technical skills among its population, consistent with Solow's model which identifies technological progress as the primary driver of improved living standards.

The analysis reveals that transient shocks to government consumption and internet usage significantly explain fluctuations in per capita GDP, secondary only to the variable's own innovations. This finding is corroborated by in-depth interviews, which indicate that despite increasing embargo pressures since the early 2010s, the period of 2009-2011 demonstrated relatively better economic conditions due to properly

allocated construction expenditures. While provincial incomes declined in subsequent years under sanctions, necessary government current expenditures helped maintain workforce motivation. Although infrastructure investment initially decreased, the adoption of Islamic Treasury instruments in 2016 coupled with an 83% increase in provincial tax revenue significantly restored growth momentum.

Notably, Hamedan's economy remains predominantly service-oriented rather than industrial, with household expenditures largely directed toward basic needs rather than productive investment. For long-term development, mobile technology adoption emerges as the most influential factor in provincial intelligentization and economic growth. As Rodrik (2016, 2018) and Wamboye et al. (2015) establish, mobile penetration enhances accessibility—particularly in rural and underserved areas—enabling financial inclusion and continuous economic connectivity. Conversely, broadband and fixed internet infrastructure demonstrate limited impact despite adequate bandwidth availability, primarily due to institutional and regulatory constraints rather than technical limitations.

The study further confirms that population growth shows no significant correlation with economic expansion (Myovella et al., 2020), while non-strategic government spending may yield negative long-term effects. Conversely, infrastructure investment consistently correlates positively with economic growth, reinforcing established findings in economic literature. These results underscore the necessity of addressing regulatory barriers and improving the business environment to fully leverage digital technologies for sustainable development in Hamedan province.

Policy Recommendations

1. Comprehensive Institutional and Regulatory Reform

Provincial development of an innovative economy requires simultaneous attention to cultural development, legal frameworks, and institutional requirements. While businesses naturally gravitate toward innovation, provincial authorities must focus on creating enabling environments through:

- Substantial revision of existing regulations to support digital transformation and business intelligentization
- Enhancing policy stability and strengthening the rule of law
- Addressing institutional barriers identified as primary constraints by

local entrepreneurs

2. Financial Sector Modernization and Investment Promotion

Financing remains a critical challenge, exacerbated by currency depreciation and high inflation. Recommended measures include:

- Developing innovative financing mechanisms for production units and digital startups
- Implementing incentive policies to redirect investment from speculative assets (e.g., gold, foreign currency) to productive sectors
- Establishing clear regulatory frameworks for foreign direct investment, particularly from multinational technology companies

3. Human Capital Development

Building digital capabilities across the population is essential for sustainable intelligentization:

- Integrating digital literacy into formal education curricula at all levels
- Establishing specialized training programs in emerging technologies through partnerships with academic institutions
- Creating retraining initiatives for existing workforce to address skill gaps in the digital economy

4. Ecosystem Development and Innovation Infrastructure

A coordinated approach to ecosystem development should include:

- Formulating a comprehensive provincial smart economy masterplan encompassing health, transportation, education, and government services
- Establishing innovation districts and technology parks that colocate startups, established companies, and research institutions
- Developing specialized infrastructure including testing laboratories, venture funding mechanisms, and business acceleration services

5. Mobile-Centric Digital Inclusion Strategy

Given the demonstrated impact of mobile technology compared to fixed internet:

- Prioritizing expansion of mobile network coverage, particularly in rural areas
- Promoting mobile-based financial and government services
- Supporting development of locally relevant mobile applications and services

6. Institutional Capacity Building

Enhancing institutional efficiency through:

- Modernizing existing institutions to better support digital transformation
- Creating new specialized institutions addressing emerging needs of the intelligent economy
- Establishing clear accountability mechanisms and performance metrics for institutional reform

7. Stakeholder Engagement and Knowledge Transfer

Facilitating connections through:

- Organizing professionally curated technology events and business matchmaking sessions
- Creating platforms for knowledge exchange between traditional businesses and technology startups
- Developing international partnerships for technology transfer and best practice sharing

Implementation Considerations

The transition to an innovative economy represents a necessity rather than a choice for Hamedan province, given its current economic challenges and opportunities. Successful implementation will require:

- Strong political commitment and coordinated inter-agency collaboration
- Phased implementation with clear milestones and accountability mechanisms
- Continuous monitoring and evaluation to refine strategies based on performance data
- Balanced approach combining infrastructure development with institutional reform

By adopting these recommendations, Hamedan province can leverage digital technologies to address unemployment, stimulate economic growth, and create a more resilient and inclusive economic future.

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